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COMPARATIVE PHYSIOLOGY AND PSYCHOLOGY.

BY S. V. CLEVENGER, M.D.

THE science of psychiatry will advance in proportion to the development of psychology based upon comparative microscopic anatomy and a physiology into which molecular physics shall enter more in the future. The entire fabric will be a triumph of monism, for if we set out on any other assumption, such as the dualistic affords, than that mind is a product of chemical energy and other natural forces, there is an end to inquiry.

The baleful influence of teleology hangs over the average physiologist as over the superstitious laity and debars him from seeing things as they really are. The inability to conceive of consciousness as a product of the motions of matter is on a level with the inscrutability of the nature of ultimate force and atoms. In dealing with the workings of the mental mechanism it is not necessary to define or attempt to explain consciousness any more than the practical electrician or chemist or optician finds it necessary to define or speculate upon the ultimate nature of the vibratory terms in which they deal. As the physicist increases his knowledge of *how* matter and motion act and react upon each other, he is willing the metaphysicians should quarrel over the unknowable, the lunar politics. With the dawn of comparative psychology the truth began to appear, theories became subordinated to facts and not facts to theories.

Not only are the laws which bind the social organism similar to and derived from those which govern the units of which it is composed, but the protoplasmic units are governed by the same processes down to chemical affinities.

H. C. Sorby[1] estimated the number of molecules in $\frac{1}{1000}$ inch sphere of albuminous substances to be

Albumen	10,000,000,000,000
Water	520,000,000,000,000
Water in molecular combination	530,000,000,000,000

and claims that we are as far from seeing the ultimate constitution of organic matter with our highest and best powers as the naked eye is from seeing the smallest objects which they now reveal to us, and that there seems no hope that we may ever see them, for light is too coarse.

This is a limit to our sense appreciation of the subject. Reason enables us to make safe guesses beyond the senses, but having them for a guide and acknowledging that science does not require final but effective causes.

The "selection" of food which is suited to the Amœba becomes "selection" or mere chemical attraction depending upon how you look at it. For instance, let the assimilable pabulum consist of molecules for which the protoplasm has affinities or attractions, the Amœba will not only be drawn to it locomotorially, but will fuse about it. As it is drawn into and becomes part of its tissue, there is undeniable chemical union, the inert resulting matter is left behind or excreted in the movements. The inert matter not only does not attract the animal, but even its passing by or over it the assimilative motions are not provoked. There could be an endless wrangle over the nature of this act of the protozoön, for it involves the most weighty considerations in all life. There is much to be said on all sides, but the moment the acknowledgment is made that chemical affinity and other physical influence is not the so-called will power of the Amœba, that moment there is an end to investigation. Admitting that these natural causes exert entire control of the protozoön, and forthwith the postulate proves its correctness in exact proportion to the correctness of the logical methods used in reasoning therefrom.

Much of the perplexity into which the student has been thrown by regarding these movements has arisen from want of consideration of the composition of resultants of attraction from many points in the medium or environment due to light, heat, eddies, vortices, disseminated invisible attracting points, the assimilative process itself changing the conditions of attraction, as in plethora;

[1] Presidential address Royal Micros. Soc., Feb. 2, 1876.

as might be expected, movements cease, owing to combinations being satisfied for the time. Then too the simple nature of protoplasm has been by no means proven. It is being regarded as not only complex through atomic union, but as holding in its molecular construction secrets which the chemist may some day find operative in the inorganic affinities. There may be, as has been surmised, many kinds of protoplasm, and the ultimate basic substance may be beyond. The ova of the different animals seem to be protoplasm plus other things, differing from each other in quantities and composition. We know that certain animals add to their bodies chemical substances which form tissues, and that other animals do not, showing a variability of selective affinity. The psychologist who attempts to explain consciousness on the basis of molecular reaction is no more at a loss than the chemist who accepts such words as catalysis and isomerism as representing acts of the atoms.

Starting out, then, with the fair understanding that the Amœba moves by virtue of the operation of physical causes, and that speculations upon the origin of matter and force are foreign to the subject, we will see to what the assumption, if you choose to call it one, will lead.

I invite earnest attention to the proposition I make here as a corollary from the apparent volition of the Amœba being molecular attraction.

Locomotion and prehension of the Amœba are due mainly to extrinsic forces operating immediately upon its organism, whereas these phenomena in man and the majority of the intermediate metazoa are due immediately to intrinsic forces, as a rule, preponderating over the extrinsic, but nevertheless the extrinsic remain the remote causes of motion in all animals.

In this there is a view of the evolution of volition from the so-called involuntary, its growth from the chemical affinities.

The belief is current among biologists that if we reverse the conditions under which all life exists, all life would perish; if the reversal were slowly effected most would perish and but few survive; if inappreciably slowly, it is highly probable that the number of surviving forms would be very large. The survival of any animal is evidence of its consonance with its surroundings, and the environment not only modifies and acts upon the animal to develop or destroy it, but also, from our chemical standpoint,

originates it. Without dipping into biogenesis, spontaneous generation somewhere, somehow, is consistent with the groundwork of our essay, but we will avoid its consideration.

Spallanzani, Dugès, Doyère and others have demonstrated that Infusoria and certain low worms, the Rotatoria, Tardigrada and some Crustacea are capable of desiccation and revival. The suspension of the major evidence of life function by animals under changed conditions, whether this be absolute desiccation or not, the development of seeds and ova, after indefinite quiescence, point toward if they do not fully attest the merging of the inorganic into the organic, and the addition of the faculty known as life through the restoration of the medium which affords the means for the molecular motions which go to make up all there is in life. So the restoration of frozen fish, and as Semper cites: "Amphibia, Mollusca and other forms have lived years without food." He "kept species of land snails for years, wrapped in paper and quite dry, in wooden boxes, and thus wholly without food, and many of them are at this day alive and active." His explanation is: "The amount of nourishment required daily by any animal must naturally be equivalent to the organic matter which is daily used up in the various organs to keep up the vital processes; the more active an animal is the more food will it require. But the vital processes of animals as low in the scale as Amphibia or univalves are extremely feeble; their respiration, even under the agitating influence of propagation, fails to raise temperature appreciably. In such the vital processes may be reduced to a minimum without loss of life."

The whole matter is one of degree, for warm-blooded animals live but a little while unfed. Hibernates are comparable in condition to "cold-blooded," while this division sustain an arrest of nutrition longer, and finally in the lowest forms the approach toward almost indefinite suspension leads us to think that there is a point where life and mere chemical conditions are identical. The repeated withdrawal of that which renders life evident entails no permanent inconvenience. Such embryos as are capable of living in a medium such as strong alcohol several days, point to the mechanical nature of certain low stages of life and the diminished liability to destruction of initial forms through heterogeneity of environment. The internal tissues of man, with their great range of chemical natures of fluids in which the cells

thrive, instance this. With differentiation and higher organization comes the increased necessity for stability of environment, paralleled by the ability of low forms to reproduce lost members, not evident in developed life.

We may regard the Amœba in many ways as having undergone development above some lower form; but pending the settlement of the bathybius question, and with a mere glance at Protista and preamœbic life, the organism affords us a convenient starting point for inquiry. While physiologists agree in its possession of the fundamental activities of life in simplest modes of manifestation, they usually content themselves with a mention of this fact and proceed to examine complex differentiated tissues as though the Amœba merited no further attention. From my way of looking at it, the Amœba, containing the solution of so much, deserves very deep consideration, which being accorded it, the apparently simple becomes intricately complex in that it explains so much.

First the environment of the Amœba: Stagnant water, mud or damp earth, or from the infusion of any animal substance in water and allowing it to evaporate while exposed to direct sunlight.[1]

It absorbs oxygen and gives out CO_2. 45° C. and strong shocks of electricity kill it; moderate shocks of electricity causes it to assume the globular still form. Crushing kills it and then even the nucleus disappears. Freezing point arrests motions. In its surroundings there are, besides its food, air, water, mineral matter, sunlight, heat and cold, mechanical vibrations.

At 35° heat stiffens it, at once proving the development of the Amœba for its medium, and that of the white blood corpuscle, which is more sluggish, for a different one, the temperature of the blood currents of the different animals. This may be regarded as an acquired adjustment.

Its molecules are subject to the law of gravitation. Light attracts it; heat increases, within limits, its activity; vibrations, such as eddies of its medium, move it; electricity stuns it; its intimate structure assimilates, chemically, the substances for which its molecules have affinities, and being nonresponsive to those for which it has not, consigns them to the exterior.

Now if all these forces act upon and in the Amœba, what is to prevent external forces from pulling or pushing out its pseudo-

[1] Practical Biology, Huxley and Martin.

podia, and with the cohesion of its mass flowing its granules into the pseudopodium most attracted, and thus drawing it bodily in the line of the resultant of all its external and internal forces. The multiplicity of the components of the resultants are evident upon watching it.

However highly differentiated the desires of man may be, and however he may fail to recognize the attraction of his own cells for pabulum, as soon as the food is placed within reach of the enteric cells, *their* affinities are not masked. If a complex organic protoplasm has the capacity of chemical conversion and union with oxygen and other molecules, and at the same time the union of oxygen with hydrogen under the proper circumstances is through such conditions which favor the mutual attraction at a distance, we cannot avoid the idea that a similar effect is produced upon the bioplasm, and that affinity for its food is a chemical energy which is one of the forces forming, with other modes of motion or attraction, a resultant, each of these attracting inversely as the square of its distance, and directly as its mass. Because the protozoön does not go straight toward its food, it is thought not to be attracted by it, but when in contact the pseudopodia envelop it, then it is said to be a will effort. When in contact then the assimilation is possible and chemical energy asserts itself as a larger component of the general forces which make resultant motions, when at a distance the food becomes one among many influences upon its movements.

Prehension, which is here evidently locomotory, is for the obtaining of food, and is caused by a number of natural extrinsic forces or attractions combined with a lesser number of intrinsic forces or attractions.

Chemical affinity is the prime cause of assimilation. Locomotion is evidently here only a form of the latter, due to the former as a direct cause, not accidentally aided, often interfered with, by other similar natural forces, inasmuch as the Amœba may be drawn away from his food unless it be near enough, or there be a compensatingly large enough amount to draw it against opposing attractions.

Throughout animal life to the highest with the development of food-procuring faculties this rule still holds good. The more the faculties increase the more direct is the food acquisition and the less do generally coöperate, but in this regard interfering

forces influence food procuring. Atavism is prominent in doing that which drives from a base of supplies or want of foresight in improvidence.

Prehension is an accessory to locomotion, and both are assimilative acts, or acts which have for their end the assimilative.

This also is evident in full development, for every act or movement of the body is of a prehensile nature. Leg movements take hold of the ground through gravitation to carry the body in search of food; hands and arms being directly prehensile; jaws are prehensile in their food grasp; ribs are prehensile in their assisting oxygen introduction, that gas being a food. In snakes the ribs are locomotory prehensile.

We thus have all the physical forces, including gravitation and chemical energy, acting upon the low organism to cause *all* its motions. Just as the heat of the sun overcomes by its gravity the earth's, and lifts billions of tons of water from the ocean to allow it to fall again in obedience to terrestrial attractive force, so may the "vitality" of an animal or plant, *apparently* working against physical laws, lift the child from the embryo, the tree from the seed, but eventually the cycle is complete and the primitive elements are separated in "death" to reënter at once upon other changes. The natural forces are masked in life-phenomena as the law of gravitation is, though the direct agent, not recognized in the upward rush of the fountain.

The Amœba assimilates organic matter and breathes as it uses up oxygen and exhales carbonic acid. To complete the objective study of the Amœba we observe that it *grows* as a consequence of its eating, and that owing to its growth and the operation of the attraction of gravitation, a force too often neglected in consideration by physiologists, *fission or reproduction* occurs, as the cohesive attraction of its molecules cannot pass beyond a certain limit, and the extra weight is gravitated, *excreted* off, a process still evident in all animal reproduction and through excretory channels also.

We also see that the sexual act is *identical* with eating in the so-called neutral, genuine hermaphrodite, form. This is more apparent in other Protozoa as a differentiation. I append my article on this subject from *Science* (N. Y.), June 1, 1881:

A paper on Researches into the Life-history of the Monads, by W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D., was read before the Royal Microscopical Society,

Dec. 3, 1873, wherein fission of the monad was described as being preceded by the absorption of one form by another. One monad would fix on the sarcode of another and the substance of the lesser or under one would pass into the upper one. In about two hours the merest trace of the lower one was left, and in four hours fission and multiplication of the larger monad began. A full description of this interesting phenomenon may be found in the *Monthly Microscopical Journal* (London) for October, 1877.

Professor Leidy has asserted that the Amœba is a cannibal, whereupon Mr. J. Michels, in the *American Journal of Microscopy*, July, 1877, calls attention to Dallinger and Drysdale's contribution, and draws therefrom the inference that such cannibalistic act of the Amœba is a reproductive one, or copulative, if the term is admissible. The editor (Dr. Henry Lawson) of the English journal, Oct., 1877, agrees with Michels.

Among the numerous speculations upon the origin of the sexual appetite, such as Mandeley's altruistic conclusion, which always seemed to me to be far fetched, I have encountered none that referred its derivation to *hunger*. At first glance such a suggestion seems ludicrous enough, but a little consideration will show that in thus fusing two desires we have still to get at the meaning and derivation of the primary one—desire for food.

The cannibalistic Amœba may, as Dallinger's monad certainly does, impregnate itself by eating one of its own kind, and we have innumerable instances among Algæ and Protozoa of this sexual fusion appearing very much like ingestion. Crabs have been seen to confuse the two desires by actually eating portions of each other while copulating, and in a recent number of the *Scientific American* a Texan details the *Mantis religiosa* female eating off the head of the male Mantis during conjugation. Some of the female Arachnida find it necessary to finish the marital repast by devouring the male, who tries to scamper away from his fate. The bitings and even the embrace of the higher animals appears to have reference to this derivation. It is a physiological fact that association often transfers an instinct in an apparently outrageous manner.

With quadrupeds it is undoubtedly olfaction that is most closely related to sexual desire and its reflexes, but not so in man. Ferrier diligently searches the region of the temporal lobe near its connection with the olfactory nerve for the seat of sexuality, but with the diminished importance of the smelling sense in man the faculty of sight has grown to vicariate olfaction; certainly the "lust of the eye" is greater than that of other special sense organs among Bimana.

In all animal life multiplication proceeds from growth, and until a certain stage of growth, puberty, is reached, reproduction does not occur. The complementary nature of growth and reproduction is observable in the large size attained by some animals after castration. Could we stop the division of an Amœba, a comparable increase in size would be effected. The grotesqueness of these views is due to their novelty, not to their being unjustifiable.

While it would thus seem apparent that a primeval origin for both ingestive and sexual desire existed, and that each is a true hunger, the one being repressible and in higher animal life being subjected to more control than the other, the question then presents itself: What is hunger? It requires but little reflection to convince us of its potency in determining the destiny of nations and individuals and what a stimulus it is in animated creation. It seems likely that it has its origin in the atomic affinities of inanimate nature, a view monistic enough to please Haeckel and Tyndall.

Dr. Spitzka, in commenting on the foregoing in the same journal, June 25, 1881, says:

"There are some observations made by alienists which strongly tend to confirm Dr. Clevenger's theory. It is well known that under pathological circumstances relations obliterated in higher development and absent in health, return and simulate conditions found in lower and even in primitive forms.

An instance of this is the *pica* or morbid appetite of pregnant women and hysterical girls for chalk, slate pencils and other articles of an earthy nature. To some extent this has been claimed to constitute a sort of reversion to the oviparous ancestry, which like the birds of our day sought the calcareous material required for the shell structure in their food (?). There are forms of mental perversion properly classed under the head of the degenerative mental states with which a close relation between the hunger appetite and sexual appetite became manifest.

Under the heading "Wollust, Mordlust, Anthropophagie" Kraft-Ebing describes a form of sexual perversion where the sufferer fails to find gratification unless he or she can bite, eat, murder or mutilate the mate. He refers to the old Hindoo myth of *Civa* and *Dúrgá* as showing that such observations in the sexual sphere were not unknown to the ancient races. He gives an instance where after the act the ravisher butchered his victim, and would have eaten a piece of the viscera; another where the criminal drank the blood and ate the heart, still another where certain parts of the body were cooked and eaten.[1]

Nature, London, commenting on my article, quoted. "Mulieres in coitu nonnunquam cervicemque maris mordunt," from Ovid, I suppose.

The locomotory, which exhibits all the prehensile acts undifferentiated, is a product of a number of natural forces, and so far as we can speak of atoms having objects, the object of locomotion is food procuration.

Prehension, locomotion, assimilation, growth, excretion, reproduction are so combined as to appear inseparable, all are molecular motions integrating to form mass motions, and the latter to facilitate the first.

Keeping this in sight as a biological fact it will simplify subsequent inquiry.

Adjustment and readjustment of the animal perpetually occurs, the reaction of the protozoön upon its environment is possible only through the intimate structure of the animal having been modified by the environment, this consists in molecular changes ending in mass changes.

This tendency is exhibited in the frequent appearance of a part unable to throw out pseudopodia, which gravitates to the rear

[1] Ueber gewisse Anomalien das Geschlechtstriebes. Von Kraft-Ebing. Arch. f. Psychiatrie, VII.

and thus becomes the hinder part, this occurs in the proteus animalcule temporarily, and in other Amœba forms as a permanent differentiation.

The ectosarc is composed of denser but mobile material due to separation of granular and molecular matter by natural causes.

The vacuoles are with reason assumed to be watery or gaseous spots filtered from the assimilative process, their constant appearance and disappearance are doubtless chemical and mechanical. The CO_2 and water holding in solution or suspension fine excretory material will find its way out through diffusion, and the elasticity of the sarcode with other larger particles gravitated out through any temporary channel. This process is apparent, though better provided for, in cloacal animals whose watery, gaseous and solid excreta are poured forth from fixed, often the same orifices. The gastræa stage is this condition in full.

If with ingestion of food and oxygen the animal increases its bulk faster than the ectosarc can accomodate itself to the change, extraneous matter, such as carbonic acid and water, *must* be propelled away from the protoplasm for which it has no affinity, and under the operation of incessantly recurring similar causes it is not surprising that this rythmical diastole and systole should often become quite regular.

We thus have inspiration of oxygen as an assimilative act in its affinity for the protoplasmic molecules together with the other accretive atomic motions and elasticity of the ectosarc instituting rythmic contractions to expel inert products. If this be admitted then *the inspiratory oxygenation of every enteric and arterial cell from the food and blood is the direct cause of vermicular motion and pulsation.*

The motions of the Amœba are assimilatory, prehensile locomotory, accretory, inspiratory, expiratory, excretory, reproductory.

Turning now from the objective method let us examine this primitive form subjectively. The objections to an application of the latter process to amœbic movements are equally valid against all other animals, even man. We know nothing of the workings of consciousness in others except by comparing like effects and inferring from them similar causes. We have the various molecular and molar workings of the Amœba as a guide in determining what it feels, likes and dislikes. Descartes' conclusion,

"Cogito ergo sum," Huxley regards as "non sequitur." I would merely postulate both ends of the sentence as being for physiological study, unassailable: "Sum et cogito," and let the metaphysicians wrangle over the rest. The Amœba's functions are simple but nevertheless the same as our own. Forthwith we must assign it a desire for food, which desire is the chemical affinity of atoms, then the Amœba hungers. This, Professor E. D. Cope[1] assigns as "the primitive desire and a form of pain. This was followed by gratification, a pleasure, the memory of which constituted a motive for a more evidently designed act, viz., pursuit."

Dividing primitive desires arising from (or with, if you wish) the atomic affinities into those which subserve and those which oppose assimilative processes, we have the origin of pain and pleasure, under which two heads all conscious workings may be classed.

Pain increases with the quantity of atoms unsatisfied. As long as there are protoplasmic molecules with affinities, the number of them wanting food increases the desire (attraction directly as the mass). Of course as soon as destructive starvation breaks down the molecules the desire ceases.

This is evident in the final loss of desire for food in extreme deprivation in man.

All unsatisfied desire is painful, as:

Hunger in the absence of food.

Desire to move about while disabled from so doing.

Desire to excrete when prevented by any cause.

In the act of satisfying desires pleasure is apparent:

Hunger appeased.

Movement unconstrained.

Emunctories unobstructed and excretion active.

All pains and pleasures are relative and intense in proportion to the precedence of one or the other extreme.

The pangs of parturition are obstructive excretory, and what obstetrician has not noticed the happiness of accomplishment by the mother.

A pleasure is often wholly due to the preëxistence of pain, and bearing upon the evolution of the reproductive excretory cellular into a desire which in its influence upon animal life is second

[1] Origin of the Will, *Penn Monthly* for June, 1877, p. 446.

only to that of hunger, this relativity must be borne in mind. The pleasurable anticipation of eating is a memory, the physical basis of which in the Amœba is a motion of the molecules involved in assimilation; their activity, their tension (the hungry Amœba is always more active than when fed). The reproductive excretory is in the Amœba scarcely to be called a desire, so dependent is it upon the performance of the assimilative act. The desire is invoked in exact proportion to growth from assimilation, provided other means of consumption of this growth are not operative.

This is obvious throughout all animal life. When hunger is extreme the sexual desire is absent. Full meals sometimes excite voluptuous feeling. The repression of this excretory desire for a time becomes painful until readjustment enables vicariation. The desire to excrete the sperm cell is the male peculiarity, the desire, when present, of the female being, as shown in the *Science* article, identical with hunger. It is the hunger of the ova which are part of the female and which by differentiation have come to be capable of satisfaction in the manners to which they have grown.

From the synamœba stage, with its denser envelope preventing the escape of the cells for a longer period this sexual excretory desire would increase differentiation of the sexual hunger from the general hunger, is shown in the Drysdale and Dallinger monad.

C. M. Hollingsworth[1] on the "Theory of Sex and Sexual Genesis," assigns causes determining sex: "Since germ cells are large and sperm cells are small, it may be at once inferred that where they are formed in different parts of the organism, the parts in which germ cells or their producing organs are formed, must be parts in which the conditions are especially favorable to nutrition; and that the parts in which sperm cells or their producing organs are found, must be relatively unfavorable to nutrition and favorable to cell division."

"The hypothesis is that a *relative* preponderance of the conditions on which cell division depends causes the formation of the female or male generative organs, or determines the sex of the individual."

Extending this to the Amœba the pure relativity of sex is seen.

[1] AMERICAN NATURALIST, July and August, 1884.

If the Amœba had undergone differentiation above some form by which it was engulfed, it could be regarded as the male. If it were swallowed by a synamœba then it is the female cell, and the product of this sexual eating would be either male or female—synamœba or amœba according to the preponderance of differentiating influence or the disposition to increase by fission on the resulting fused mass.

Desires consisting of atomic tensions or affinities, the conditions of continuance or satisfaction of desire, involves feeling or sensation, a low form of consciousness; this is justified in considering our developed similar states during the same processes of hungering, eating, etc., and as in us repletion discontinues desire, so does it in the lowest form of life we are discussing.

The sensations involved in assimilation would be difficult to separate from those concerned in pseudopodia-protrusion or general locomotion, as they are identical in effect in the Amœba; admitting their identity, it is easy to see how, by invagination of the ectoderm the later differentiation could occur by an enteric tactile developing in one direction while the ectodermal would change with direct reference to locomotion or prehension. But, as even when the enteron is formed, a prehensile tactile sense is retained and developed, analogies between the same distributions to external and internal parts remain though the sensations in many respects differ. The passage of materials in the intestines awaken few feelings so long as the adjustment is not disturbed, on the same principle that we do not feel external ordinary stimuli perpetually recurring.

Pressure is the feeling of constraint, interference with molecular and mass movement, it is a painful state of consciousness arising from the inhibited movements, the desire to move being consequent upon proper assimilation, and is referred to an interference with that function.

The hunger pain and appeasing hunger pleasure are due to and consist in chemical tensions and release from tension, the absence and presence of certain molecules. This carried up the scale of Metazoa convinces us that desire, feeling, sensation reside *in every living cell in the body*, and are not seated exclusively in nerve tissue. With the differentiation of function there will proceed changes of degrees of intensity of certain feelings in those living cells, but the fundamental hunger pain and pleasure of its gratification are never differentiated out of existence in any cell.

Desires, feelings, sensations, consciousness, cognitions, ideas, memories, emotions, etc., are one and all *conditions* of the molecules of the cells, and in the ravenous though unavailing appetite of some diseases wherein nutrition is at fault, the feeling is shown not to be solely located in the intestines but all over the body, and the inability of physiologists to locate centers for desires in the brain is explained. Whenever the exhibition of a feeling or a feeling itself has been destroyed through injury, it has been through failure of the *tracts* which convey molecular movements generated by such feelings from the now nervous bodily cells wherein those feelings are highly developed. *The nerves are pure association systems, and where the feeling aroused in an organ had become, through constant repetition, associated with certain other feelings or with a motor expression, then nerves of association would be built up through least resistant lines.*

The organism consisting in the sum total of the life activities of its cells, the dissociation of the organism from its locomotory organs, the legs, cut off the ability to walk, and paralysis of strands leading to the legs dissociate similarly.

Cutting off the organ of special sense or destroying its tracts similarly dissociate. There is a difference between cells acting for themselves or acting unitedly with others.

Returning to our Amœba, the mobile granules and molecules moved with every impulse. Its sensations were motions and its motions sensations, the two were inseparable. With a change in the density of its ectosarc, retarding fission, the morula form arose and in the break of the envelope Amœbæ are, as might be expected, liberated, but they have inherited this molecular development of ectosarc induration and develop into synamœbæ as did its parent.

The planæada developed cilia through a similar law. Owing to the difficulty of withdrawing pseudopodia once protruded, these atrophied into vibratile organs through starvation, and the hunger motions of the cells set up oscillations of the cilia which, subserving the life purposes better, were perpetuated and the motions of the cells adjusted themselves to the necessity and brought the environment food to itself by causing eddies, and a new means of locomotion arose. Still sensation and motion were identical, for the molecular movements constituting sensation ended in their summation of motions into gross locomotory motion, except that

the cilia were organs of locomotion while the body remained sensitive. We may regard the cilium as formed of dead material in the main, Dallinger and Drysdale's monad rejected it in eating its companion. This would shadow forth the possibilities of a set of ciliary vibrations becoming known to the animal as tactile locomotory, differing from, though ministering to, hunger sense, and a change in the aggregation of the cell granules would follow. When the cell granules moved in keeping with the ciliary motions either the locomotory memory or act was aroused, if in accordance with hunger movements then the memory of hunger was aroused and this could react on the cilia to move them. When the ectoderm reached a stage of hardening admitting of no more strain upon it, the central contents transuded by some means, probably temporary rupture. The gaseous and watery contents escaped and the animal collapsed into the gastræada stage. The enteric cilia still remain as originally developed, but of course changes between ectodermal and endodermal experiences would differentiate the two areas. The inner remained subject to constant encounters, or nearly so, and the outer had the brunt of every change.

The acœlomotous Turbellaria appear to me to be more of an aberrant type not in our phylum, many of the forms have undergone much development. The delamination origin of the gastrula stage could be one of those ontogenetic short cuts often made in copying phylogenesis, the end attained being the same.

The Scolecid presents the most evident progress toward development in the vertebrate direction. Its cœlom contains the first nutrient fluid allied to blood, but its circulation is not established. The denudation of the useless external cilia, though occasionally developed into stiff setæ, in a turbellarian follow the locomotory process, changing to that characteristic of worms, elongation and contraction of the body length. Hubrecht's Pseudonematon illustrates this movement, through the alternate contraction of longitudinal and circular muscles with a plexiform nervous system between. The motion is in some respects similar to the flow of amœba granules forward into an arm, but organization has restricted this to a to-and-fro motion. The shape of the body rendering this the easiest mode of progress, the sum of the life activities act in least resistant lines to elongate and then contract the worm. Cause and effect exchange places in the circu-

lar fibers, being placed, through the motion of elongation, in a state of inertia, enabling the contraction of the longitudinal with consequent adjustment of the circular fiber molecules, so they can act to advantage. The repetition of these two opposed motions through the epidermal confinement of the skin, rendering them about the only ones that could be made, initiated by the attractive affinities of the protoplasm, finally developed the contractile tissue. The ventral location of the nervous system in the Errantia and others is due to development through use of that region differentiating locomotor areas from the epidermis, and in Insecta it is the persistence of the phylogenetic origin. In the worm stage the external tactile becomes fully developed through the heterogeneity of molar vibrations to which it is subjected.

One method of locomotion being possible, another is also possible, differences or variations in one or the other, such as could be caused by mechanical means, could result in a sinuous movement arising from want of rigidity in the worm length. A complex of causes, simultaneous and successive, operate to change the usual mode of locomotion and introduce so-called compound reflexes.

The formed tissue, of which Beale speaks, is often excrementitious, and has, through being useful, been retained by the cells. The sandy covering of the rhizopod, *Astrodiscus arenaceus*, may have been "selected" by agglutination of the envelope with the particles, or the shell of a mollusk may form through excretory processes or a covering may be acquired by squatter right as with the hermit crab. It matters little to the animal. The fighting cock will use the steel gaffs with as much gusto as though they had grown from his legs, nor is the cell a particle more particular. If it find in its environment matter with peculiar properties it will, through "selection," eat what it can and excrete the rest. If the excreted material have enough affinity for the cell to remain in its vicinity, and a life process is subserved by that fact, things chemical and mechanical in nature will conspire to associate the material with the cell. I regard nerve granules, such as are found arranging themselves or being arranged into first plexuses of fibers and then definite tracts, as having arisen accidentally. As the rhizopod could not have acquired his overcoat where there was no sand, the ancestral worm which picked up a nervous system could not have done so in the absence of

assimilable phosphates. The resulting nervous system became more and more definite in tract formation as motions became more and more definite between parts. These nerve granules had a molecular mode of action altogether different from anything experienced before by the animal. In higher forms the cell substance, which had the particular ability to excrete or secrete it (relative terms), formed along the area of the plexus and tracts, next an encapsulating membrane formed about it, in obedience to ordinary physiological and pathological processes that an intermediary substance will be attracted and form around tissues or even foreign substances as a resultant of the mode of operation of the two tissues. In due time areas of nerve granule generation find in itself small plexiform areas which are turning points of direction for the molecular nerve discharge, and by encapsulating these the nerve cell is formed, which I regard as having no other functions than a histogenetic one aside from the molecular impacts passing through it. From protoplasm exuding the nerve granules the nerve cells develop to that office; from indifferent tissue forming cartilage, some of the latter form osteal cells.

A plexiform rudimentary nervous system conveys irritations over the body. When the discharges become definite the linear arrangement appears as in the ascidian embryo, the head end developing through tactile and rudimentary sense organs determining there with frontal impact of environment. Most influences acting to excite the squirt or vermicular motions from mouth to anus, a method of locomotion and ingestion at the same time.

It is easy to see how the mechanical perforation of a cœlenterate sac caused the enteron to be completed, but the origin of the circulatory system is not so evident. The enterocœle is in direct communication with the enteron in cœlenterates and the fluid it contains, as Huxley says, "represents blood," it is nutrient; the lacunæ of some worms are the next step toward a blood vascular system. The pseudo-hæmal system of the Annelida contains a substance resembling hæmoglobin, and with these facts before us we may construct the vascular system and its workings in some such way this: Cœlom, a receptacle for a fluid containing nutrient matter which had strained through the endodermal cells and through interstices between them. Next the appearance of hæmoglobin or its equivalent in the cœlom. The peculiar proper-

ties of this substance consist mainly in its solubility by alkaline fluids and its affinity for oxygen, "which is linked to it by ties so easily broken that it can be transferred to other easily oxidizable bodies existing by its side, that it can be given up when its solutions are gently heated in vacuo or agitated at moderate temperatures with large quantities of inactive gases, as nitrogen or hydrogen."[1] This oxygen carrier next formed a cell especially adapted to its transportation.

——:o:——

SOME APPARENTLY UNDESCRIBED INFUSORIA FROM FRESH WATER.

BY ALFRED C. STOKES, M.D.

THE Infusoria whose descriptions are appended have as yet been observed only in the shallow ponds of Western New York, although they doubtless occur as plentifully elsewhere. Near the pretty village of Olean, in the bosom of the western hills, they pass their little lives amid attractive surroundings. Scarlet clusters of the cardinal flower and great bunches of yellow primroses make brilliant the shores of their aquatic haunts, while tall *Rubus odoratus* holds it purple roses aloft in the warm air, and *Anemone pennsylvanica* lifts its white blossoms above the "lush and lusty grass." A bird chirps in the shading maple boughs, a frog cries and splashes into the pool amid the Myriophyllum and Utricularia; a meditative cow gazes quietly at the intruding biped, and the blue sky bends above, and the blue mists rest in the hollows of the distant mountains. The placid water teems with life. A furrowed Euglena, hitherto undescribed and unseen by the eye of man, rotates like an animated screw in and out among the utricles and leaflets of the water weeds.

This green creature, which I have named *Euglena torta*, bears the remotest resemblance to any known member of its genus. The parenchyma is as usual uninterruptedly green, but the characteristic features are the spiral grooves or keel-like ridges traversing the entire body from anterior extremity to posterior acumination, where they are lost in the origin of that colorless caudal prolongation. The animalcule is but slightly flexible and apparently not changeable in shape during life. After death by poisoning the ridges and

[1] Gamgee's Phys. Chem. of the Animal Body, p. 91.

depressions disappear, and the body becomes smoothly subcylindrical. In life, however, it cannot be mistaken for any known species of the genus. Among the Euglenæ it is unique. Fig. 1 delineates it under a magnification of 360 diameters, and the subjoined description probably contains its essential specific characters.

FIG. 1.—*Euglena torta*, sp. nov. × 360.

Euglena torta, sp. nov.—Body elongated, subcylindrical and traversed by three longitudinal, spirally directed furrows, or three spiral, keel-like longitudinal elevations; anterior extremity rounded and slightly bilabiate; more or less tapering posteriorly and terminating in a colorless, acuminate, somewhat curved caudal prolongation; cuticular surface smooth; endoplasm green; amylaceous bodies usually two, cylindrical, situated one on each side of the spherical, centrally located nucleus; contractile vesicle and pigment spot conspicuous near the anterior extremity; flagellum subequal to the body in length; movement rotary on the long axis. Length of body $\frac{1}{400}$ inch. Habitat: Among Utricularia in shallow ponds in Western New York.

In movement, but in little beside, a Phacus from the same pool resembles *Euglena torta*. This rotation on the longitudinal axis it has in common with *Ph. triqueter*, *Ph. longicaudus*, *Ph. pyrum* and *Ph. pleuronectes*, the other members of the genus, all of which are more or less abundant in still and shallow waters. It is represented in its lateral aspect in Fig. 2, magnified 280 diameters. It may be described as follows:

FIG. 2.—*Phacus anacœlus*, sp. nov. × 280.

Phacus anacœlus, sp. nov.—Body broadly ovate or suborbicular, more or less compressed, the right and left sides concave, the dorsal and ventral margins each traversed by a deep longitudinal furrow, the body thus appearing to possess four keel-like ridges; caudal prolongation colorless, acuminate and curved toward the dorsal aspect of the body; eye-spot and contiguous contractile vacuole conspicuous; flagellum subequal to the body in length, inserted beneath a prominent lip-like projection; endoplasm green. Length of body $\frac{1}{600}$ inch. Habitat: Shallow ponds in Western New York.

All of the Vorticellæ are attractive, but the most beautiful form I have yet met with is one that occurs in some profusion scattered over the rootlets of Lemna from this same rich little pond. At first I was disposed to identify it with Ehrenberg's *V. chlorostigma*, but subsequent study showed that such identification could be justified only by that zoöid's probable coloration. It is considerably more campanulate in form than

the Ehrenbergian species, and has not the densely granulated parenchyma of the latter. In color it is a translucent homogeneous emerald-green. It has a frequently exercised tendency to a characteristic change of form by retracting the borders of one side of the extended body so as to produce a deep depression, while the contracted zoöid exhibits a habit of some slight diagnostic value in the sheathing of the distal end of the pedicel by the posterior extremity of the body. The cuticular surface is transversely striated by depressions so fine that they are ordinarily visible only at the lateral borders or after manipulation of the mirror. Minute granules occasionally

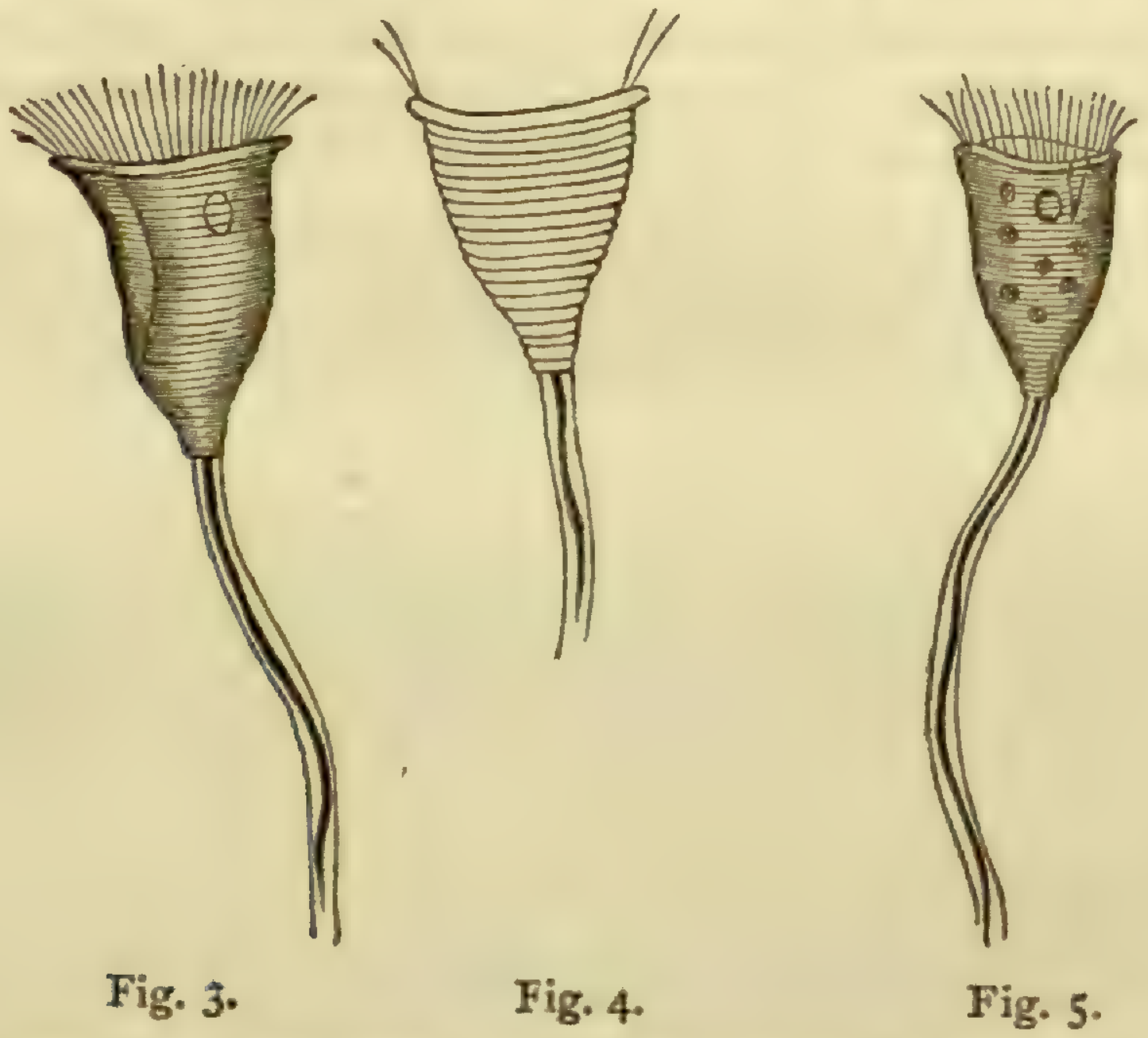

Fig. 3. Fig. 4. Fig. 5.

FIG. 3.—*Vorticella smaragdina*, sp. nov., showing lateral depression. × 180. FIG. 4.—Diagrammatic outline of *V. smaragdina* when extended. FIG. 5.—*Vorticella macrocaulis*, sp. nov. × 360.

roughen the surface and are barely visible under an amplification of 250 diameters, when they appear to add to the distinctness of the transverse striations without making themselves conspicuous. With magnification of 400 diameters they are seen to be minute, dark-bordered refractive particles arranged in no apparent order and having no connection with the surface striæ. They are not constantly present, and their absence seems to add to the beauty of this peculiarly attractive creature. When the infusorian is well and the surroundings are auspicious, but little of the contracted pedicel remains uncoiled, this atomie of living emerald then quivering at the summit of a crystalline spring, like a spherule of chrysoprase on a coil of silver thread.

The pencil can give hardly more of this exquisite creature's appearance than a diagrammatic outline, and little more has been attempted in the figures (Figs. 3 and 4). The translucent green coloration of the entire sarcode, the peculiar indentation of the side, the delicate poise of the contracted body at the summit of the closely coiled foot-stalk, the whole charm of the living creature is lost in the lines of black and white.

Vorticella smaragdina, sp. nov.—Extended body, conical-campanulate, changeable in shape, an irregular depression often formed on one lateral border; the width of the peristome nearly equal to the length of the body, the anterior margin dilated, somewhat constricted beneath the peristome border, the posterior body-half tapering to the pedicel; cuticular surface finely striate transversely and often roughened by minute, scattered granulations; peristome border everted, slightly revolute; ciliary disk very slightly elevated; the entire parenchyma translucent and colored emerald-green; vestibular bristle conspicuous; pedicel colorless, eight to ten times as long as the body, contracting in numerous close coils; contracted body subspherical, a posterior annulation sheathing the extremity of the pedicel. Length of body $\frac{1}{500}$ to $\frac{1}{300}$ inch. Habitat: Rootlets of Lemna in ponds in Western New York. Solitary or few together.

In external contour as well as in the length of the pedicel another species of the genus, which I have named *Vorticella macrocaulis*, resembles *V. longifilum* S. K. It is, however, immediately distinguished by its surface striations which, although fine, are distinct, and by the proportion borne by the length of the body to the width, the former, with *V. longifilum*, being twice the latter, while in the species under consideration these parts differ much less in relative size. No recorded member of the genus possesses a pedicel of so great a length as the one here referred to, except *V. longifilum* and *V. telescopica*, both of the latter having an unornamented cuticular surface. If this contractile foot-stalk were delineated under an amplification equal to that of the body in Fig. 5, it would necessarily be depicted from six to seven inches long, being ten to twelve times the length of the extended zoöid.

Vorticella macrocaulis, sp. nov.—Body elongate-campanulate, one and one-fourth times as long as wide, attenuate and tapering posteriorly; peristome somewhat wider than the greatest width of the body, everted and thickened but not revolute; ciliary disk evenly rounded and elevated; cuticular surface finely striated transversely; contracted body obovate; pedicel ten to twelve times as long as the extended body, its entire length contracting into close coils. Length of body $\frac{1}{600}$ inch. Habitat: Shallow ponds in Western New York, attached to Lemna rootlets. Solitary.

Still another species of Vorticella from the same habitat is that

shown in Fig. 6 under the name of *V. utriculus*, which resembles in form *V. striata* Duj., a salt-water infusorian. In its conspicuous surface striations it also suggests the marine animal, and in size, furthermore, the two somewhat closely correspond. In the comparative proportion of breadth and length they differ, also in width of peristome as well as in the length of their respective pedicels, that of the marine form being twice and that of the sweet-water species three times as long as the body. *V. utriculus* may be a fresh-water variety of *V. striata.* The coincidences of

Fig. 6.

Fig. 7.

FIG. 6.—*Vorticella utriculus*, sp. nov. × 437. FIG. 7.—*Vorticella macrophya*, sp. nov. × 535.

form and other essential characters are at least interesting and suggestive.

In its habitat it is disposed to be solitary, although it does not object to neighbors if not too near. Usually when one is found others are to be noted arranged singly on the same Lemna rootlet, and at almost equal distances apart. When contracted the pedicel is coiled in close rings, and has its distal end sheathed by the posterior termination of the body in a manner similar to that of *V. smaragdina* when in the same inactive state. It is shown extended in Fig. 6, magnified 437 diameters, and may be described thus:

Vorticella utriculus, sp. nov.—Body vase-shaped or subpyriform, somewhat changeable in shape, twice as long as broad, widest centrally, tapering posteriorly, and slightly constricted beneath the everted and revolute border of the peristome, whose width is a little less than the greatest breadth of the body; cuticular surface strongly and conspicuously striate transversely; ciliary disk slightly and obliquely elevated; vestibular bristle conspicuous; pedicel three times as long as the body; contracted zoöid obovate or pyriform. Length of body $\frac{1}{625}$ inch. Habitat: Attached to Lemna rootlets in ponds in Western New York. Solitary or scattered.

Descriptions of several members of one genus must necessarily contain much repetition wearisome to the general reader. The records can be scarcely more than comparisons of contour and structure, resemblances and dissimilarities. The habits of the numerous kinds of Vorticellæ are essentially the same. This particular one that I have named the "long-shaped" Vorticella, *V. macrophya*, bears a striking resemblance to *V. cucullus* From., and might justly be identified with that species, were it not for the presence of cuticular striæ and the absence of the cushion-like ciliary disk.

It is an interesting coincidence that this and two preceding forms from the same little pool, although they so widely differ, should so uniformly present, when contracted, the small annular sheath about the attachment of the pedicel. In every instance that portion of the zoöid which accompanies the distal end of the stem into the body remains included until the animal is otherwise almost completely expanded, when that part slips out quite suddenly and so completes the act of dilatation. The Vorticella is shown expanded in Fig. 7, magnified 535 diameters.

Vorticella macrophya, sp. nov.—Body elongate-conical or obconic, twice to two and one-half times as long as broad, widest at the anterior margin and thence tapering to the attenuate posterior extremity; peristome border revolute, not everted; cuticular surface finely striate transversely; ciliary disk slightly and obliquely elevated; nucleus band-like, short, curved and situated in the anterior body-half; pedicel once and one-half to twice as long as the body, the muscular thread stout; contracted zoöid obovate, the posterior extremity sheathing the distal end of the spirally coiled pedicel. Length of body $\frac{1}{667}$ inch. Habitat: Attached to rootlets of Lemna from shallow ponds near Olean, Western New York. Solitary.

Jutting outward from the edge of Luna island on the American side of Niagara falls, within twelve feet of the curving brink of "the cataract which here shoots down the precipice like an avalanche of foam," projects a rock submerged and washed by the almost rythmic flow of the reflex currents from that mighty flood. There tangled clusters of a deep green Alga clung by a single point of attachment. The ripples swept above and left

them anon streaming wildly as the waters sank below the stone, only to dash them upward again as the waves rushed back. Scarcely thinking to obtain any animal life clinging to a plant that rejoiced in such swirling turbulence, I gathered the weed while my friend adhered to the extremities of my coat as desperately as the Alga adhered to that limestone rock. The plant, as the Rev. Francis Wolle, of Bethlehem, Pa., tells me, is *Cladophora glomerata* Linn.; the undescribed form of Zoöthamnium, unexpectedly found in thrifty abundance on the lower branches, is *Zoöthamnium adamsi*, sp. nov., named for the Rev. J. E. Adams,

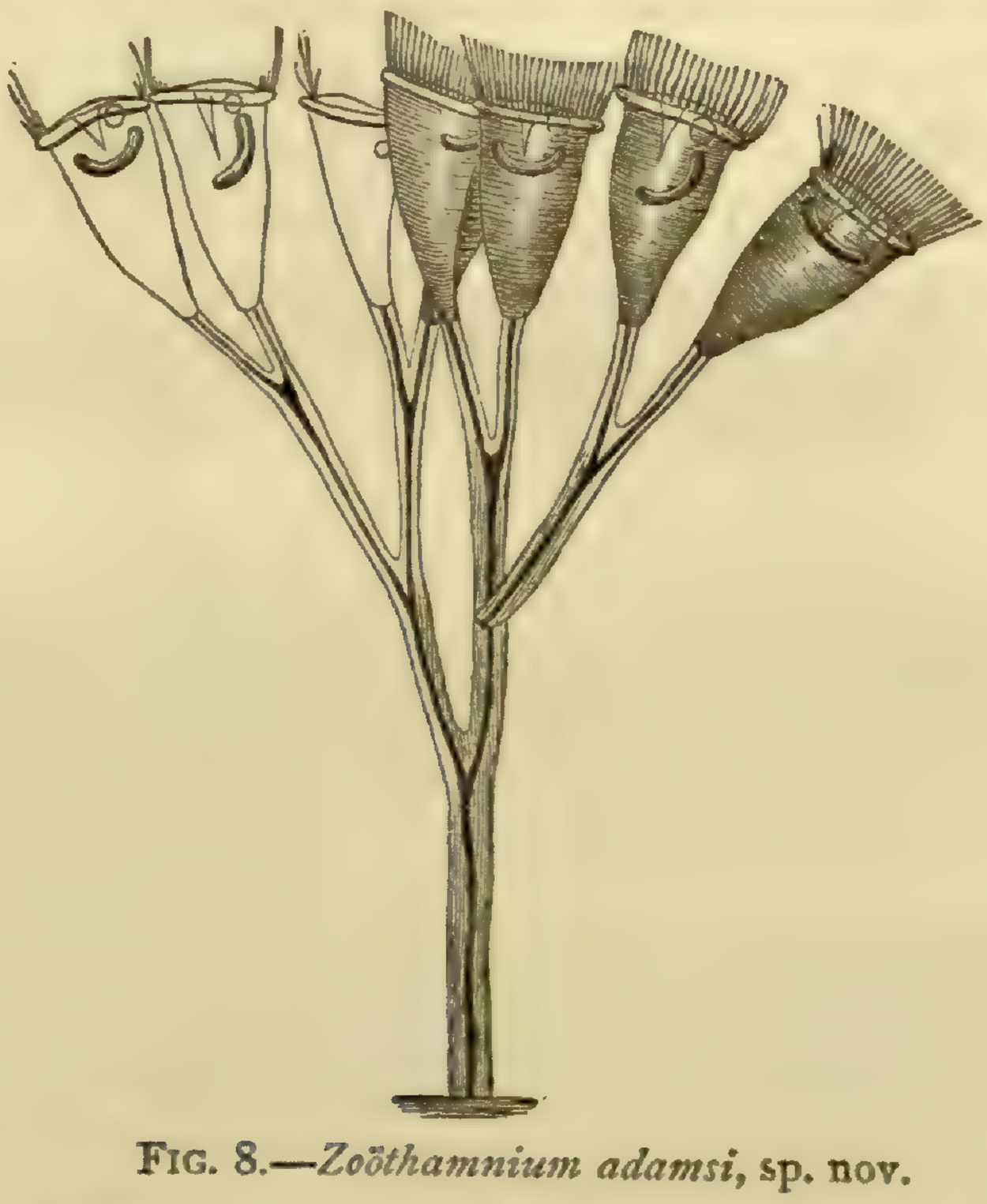

FIG. 8.—*Zoöthamnium adamsi*, sp. nov.

of Olean, N. Y., a cultured and eloquent gentleman, who assisted in its capture.

So far as external form is concerned the members of this colony resemble those of Saville Kent's *Z. simplex*, a company of elongated zoöids clustered at the summit of a smooth, unbranched stem. Both are conical, both are widest at the frontal border, both are tapering and attenuated toward the insertion of the pedicel, but here the resemblance ceases. The cuticular surface of the new form now referred to is not smooth, as is that of every other recorded fresh-water species, but is finely and delicately striated transversely. So closely approximated and so tenuous are these elevations that it is only after the most careful scrutiny under an amplification of not less than 400 diameters, that they

become apparent to a trained eye, and even then only as infinitesimal lines on the lateral borders of the extended bodies. No more careful adjustment of the objective, no more careful manipulation of the mirror is needed to study the markings of a diatom than is demanded by this little creature before its markings impress the observer's retina. In the figure (Fig. 8) they are represented by lines, fine it is true, but almost out of proportion to the elevations which Nature has placed on the living surface of the infusorial atomie, whose home was at the brink of that stupendous cataract of emerald and foam and spray-smoke, amid the eternal complaining of beaten rock and broken flood.

The supporting pedicel is usually simply bifurcated at a point distant from its algal attachment about twice as far as are the furcations of the branches from the extremity of the main rachis. Sometimes the pedicel throws off three branches from its summit, and more frequently four divisions. The prevailing form, however, is the dichotomous. Above the second series of bifurcations the branches become of diverse lengths, instances occurring in which the branchlet is twice as long as any other part. The length of the ultimate divisions, those immediately supporting the zoöids, seems quite constant, being usually about one-half as long as the extended body. The whole pedicel is stout and robust, and is conspicuously marked by longitudinal striæ. Its contractions are comparatively slow and few. There is none of that sudden coiling, as with the Vorticellæ, when the expanded infusorian leaps back into quick contractions and momentary quiescence that often startles the rapt observer.

After the colony has been under observation for a prolonged period an action takes place that I have not seen recorded with any member of the genus, a movement recalling the contractile performances of the disconnected muscular threads of individual members of Carchesium. Two neighboring zoöids fold together their ciliary apparatus, and their own private foot-stalks retract into coils without disturbing the general equanimity of the community. This has been observed repeatedly, the retracted muscular thread being, in every instance, in apparent connection with that of the remainder of the pedicel. This thread, however, seems to be delicate. For no visible reason it soon separates into numerous scattered fragments within the sheath. In those in-

stances just referred to, an inappreciable separation had probably taken place.

The contracted body, when certain adjuncts of the entire colony are taken into consideration, affords some points that may be of diagnostic value. The creature probably affects running water, or water agitated by proximity to a current, but that it is restricted to the restless waters beating the shores of Luna island and pouring a resistless flood to make that terrific plunge, is not to be thought of; there only was its original habitat so far as the writer is concerned; and when it is found, as it probably will be, in swift streams far beyond the sound of the "Thunderer of the Waters," its contracted form may offer some characters to aid in its identification. When the frontal region is folded together, and the whole body contracted, the zoöid bears some resemblance to the bodies, when in a similar condition, of *Opercularia plicatilis*, described by the writer in the *American Monthly Microscopical Journal* for December, 1884. The anterior snout-like projection, the radiating cuticular elevations, the posterior annulations, are all similar. With the Zoöthamnium, however, the conspicuously crenulated border of the projection and its longitudinal plications, of the Opercularia, are absent or obscure, while the radiating ridges on the shoulder of the Zoöthamnium are much more prominent though fewer, and the posterior annulations, though as numerous, are less marked.

The short, curved, band-shaped nucleus is constantly present in the anterior body-half, but its relative position is inconstant. At times its concavity is presented directly forward toward the ciliary disk, at others it is nearly perpendicular, with the convexity directed outwardly, and in rare instances it is transversely placed near the center of the body.

A colony of this attractive infusorian is delineated in Fig. 8. The cuticular markings, as before intimated, are chiefly shown to emphasize the fact of their existence, not to exhibit their tenuity or number.

Zoöthamnium adamsi, sp. nov.—Body elongate-conical or conical-campanulate, twice as long as broad, widest anteriorly. tapering to the pedicel, and slightly constricted beneath the peristome border; cuticular surface very finely striate transversely; peristome border wider than the body, revolute; ciliary disk rounded and elevated; contractile vesicle single, situated beneath the peristome border; nucleus short, band-like, curved and anteriorly placed; main rachis of the pedicel usually bifurcate, frequently quadrifid, occasionally tripartite; branches dichotomous, un-

equal in length, commonly shorter than the main stem, the ultimate divisions less than one-half the length of a single zoöid, each division supporting a single animalcule; entire pedicel stout, longitudinally striate; contracted zoöid obovate or subpyriform, the frontal border projecting in snout-like manner, and the anterior body-half thrown into prominent longitudinal plications, the posterior body-half into several annulations. Length of body $\frac{1}{417}$ (0.0024) inch; height of main stem $\frac{1}{334}$ (0.0030); of the entire colony $\frac{1}{112}$ (0.0090) inch. Habitat: Attached to *Cladophora glomerata* on the shore of Luna island in the rapid water of the Niagara river.

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NOTES ON THE PHYSICAL GEOGRAPHY OF THE AMAZONS VALLEY.

BY HERBERT H. SMITH.

MOST of our common maps indicate a triple division of the Amazons, the Peruvian portion being called Marañon, the Middle Amazons, Solimoens, while all below the junction of the Rio Negro is distinguished as the Lower Amazons. Geographers have treated this division as one of custom and convenience only, and so far as the Peruvian portion, or Marañon, is concerned, they are right; its distinction from the Solimoens is merely nominal, Brazilians and Peruvians speaking of both portions as the Upper Amazons. But this *Alto Amazonas* is constantly and clearly distinguished from the lower or main river. "The Amazons," say the river pilots, "is formed by the junction of the Solimoens and the Rio Negro; the Solimoens is called Upper Amazons because it is longer and has more important settlements on its banks, but it is really a branch like the Negro. Indeed, at the junction it is the Solimoens which forms an angle, while the Negro is directly in a line with the Lower Amazons, so that it appears to be the main river." This idea is universal among the river people, and it has led to many important results. The "Amazons" and "Solimoens" are well recognized in commercial affairs, and they have even formed the basis of a political division, the limits of the provinces of Pará and Alto Amazonas corresponding pretty nearly with those of the Lower and Upper Amazons.

The division is, in fact, much more significant than geographers have supposed. Whatever may have led to the distinction of names, there is a real and well-marked physical division, not only of the river itself, but of the country and its fauna and flora. Mr. Bates is, I believe, the only traveler who has clearly indicated

some of the differences between the two regions. Following him in part we may thus divide them:

1. The Upper Amazons region, to the base of the Andes and for hundreds of miles on both sides of the river, is a perfectly level expanse, nowhere raised more than a hundred and fifty feet above the river and generally only just out of reach of the highest floods. The Lower Amazons, on the contrary, passes through a comparatively high country, with table-lands several hundred feet above the river and many abrupt hills or even mountains. These elevations increase towards the north and south until they join the great table-lands of Guiana and Brazil.

2. As a consequence the great tributaries of the Upper Amazons—notably the Purús, Juruá and Içá—present a perfectly open navigation almost to their sources; but those of the Lower Amazons are obstructed by rapids and falls where the water flows down from the highlands. A secondary consequence is that the Upper Amazonian branches are very crooked, while those of the Lower Amazons are comparatively straight.

3. The soil of the Upper Amazons is either a rich ferruginous clay or vegetable mold which, according to Bates, often attains a thickness of twenty or thirty feet; stones are hardly ever met with. On the Lower Amazons the soil is nearly always sandy, and mold forms only in favored localities, such as swamps and river-banks.

4. On the Upper Amazons the trade-wind is never felt, and the air is always moist and warm; rains are very frequent, especially near the Andes, and the dry season is only marked by the comparative lightness of the daily showers. On the Lower Amazons the trade-winds blow freely during a great part of the year, and there is a well-marked dry season; in some districts the rains cease almost entirely for weeks together. Probably the average temperature is somewhat lower near the Atlantic than on the Upper Amazons.

5. The great forest of the Upper Amazons, so far as we know, is unbroken except by the rivers, and it has a width of a thousand miles or more from north to south. The forest belt of the Lower Amazons is hardly half so wide, and it is interrupted in many places by *campos* or open lands, either grassy or stony plains, without trees, or sandy tracks with a thin semi-forest growth like that of Central Brazil.

6. The alluvial flood-plains of the Upper Amazons are far more extensive than those of the lower river, probably attaining in some places a width of at least one hundred miles. They are covered everywhere with heavy forest which, during a large portion or the whole of the year are flooded, so that canoes can pass freely underneath the branches. On the Lower Amazons the alluvial belt varies in width from fifteen to forty miles, and it is occupied, in great part, by open meadows which are only flooded during the rainy season.

7. The fauna and flora of the Upper Amazons are exceedingly rich in genera and species, and they are almost entirely composed of forms which are fitted only for a forest life. On the Lower Amazons such forms are mingled with others which belong to the open lands, or which are not essentially sylvan; in general the species are less numerous than on the Upper Amazons, and many of them are distinct, but allied or "representative" forms. Those species which are common to the two regions are frequently larger and of more rapid growth on the Upper Amazons.

As may be supposed the two regions fade into each other, but something like a definite boundary between them is formed by the Rio Negro on the north and the Madeira on the south side of the Amazons. These, the former with its broad expanse of water, the latter with its immense flood-plain, are almost impassable barriers to the migration of species. They, together with the main river, divide the whole Amazons valley into four parts, each of which is characterized by a pretty large number of animals and plants. The other great tributaries may limit lesser groups of species, and the great flood-plain has a perfectly distinct assemblage of animals and plants which, in their turn, differ essentially on the Upper and Lower Amazons.

Let us now, for the moment, leave the Solimoens and confine our attention to the region east of the Rio Negro and Madeira. The valley of the Lower Amazons is limited on the north by the mountain range which separates British and Dutch Guiana from Brazil. Most of these mountains are table-topped, and they are clearly remains of a great elevated plain. The region, two or three hundred miles wide, which separates them from the Amazons, is very imperfectly known, but it appears to be almost entirely occupied by a less elevated plain, edges or spurs of which

are seen near the river in the table-topped hills of Almeyrim and Velha Pobre, each more than 1500 feet high. This plain may be regarded as a great terrace, abutting abruptly against the high peaks of the Guiana chain, and cut down as sharply near the Amazons to a second terrace which forms a low region between the table-topped hills and the river flood-plain. Sometimes an intermediate terrace may be distinguished, as at Monte Alegre and Prainha; outlying and much denuded portions of the upper terrace are seen in the rugged hills of Ereré and Tajury, west and north of Monte Alegre.

The southern side of the valley, from the Madeira eastward, seems to be everywhere a low table-land, which rises gradually or by terraces to the elevated plains of Central Brazil. Near the Amazons and its tributaries it is abruptly cut down, forming bluffs three or four hundred feet high. A line of these bluffs extends, with slight interruptions, from the Tocantins almost to the Madeira. Generally the bluffs form the southern edge of the Amazonian flood-plain, but in some places, as near Santarem, they are separated from it by strips of low land answering to the lower terrace on the northern side. The bluffs themselves may correspond to the intermediate terrace of Monte Alegre and Prainha.

Between these northern and southern terraces, crossing the country from W.S.W. to E.N.E., is a low, flat, perfectly level expanse, very irregular in outline and varying in width from fifteen to forty miles; at the Atlantic end only it spreads out like a funnel, occupying perhaps a hundred miles of coast. The yellow Amazons winds through this flood-plain, rarely touching the borders, now pouring through the narrow pass at Obidos, now expanded into sea-like reaches, again broken into two or three portions, separated by great islands. Everywhere the alluvial land is dotted with shallow lakes and seamed with channels—goodly rivers which hardly appear on the maps. Constant changes are taking place in this network; new islands and shallows are formed almost every year, and old ones are altered or washed away. I know of one island, three miles long, which disappeared completely in less than ten years; the river steamboats now pass directly over its site.

On the Lower Amazons the islands and river-borders of the flood-plain are called *varzeas*, though properly the term is applied

only to those portions which are above water during more than half the year; lower and perennially wet tracts are known as *ygapós*.[1] In contradistinction, all dry land which is out of reach of the annual floods is called *terre-firme*. Islands of high land (*illias de terra-firme*) are frequently seen in the midst of the *varzeas* and along the irregular borders of the flood-plain it often happens that the *varzea* and *terre-firme* are mingled in the most complicated manner; such places would be puzzling enough to the student were it not that the alluvial land can be at once distinguished by its vegetation. Frequently the *varzea* or *ygapó* forest is continuous with that of the *terre-firme*, but the trees are always of distinct species, and no experienced woodsman would think of confounding them.

On the southern side of the mouth of the Amazons, separating it from the Tocantins and Pará, is a great lozenge-shaped island called Marajó. At its south-western end it is separated from the mainland by a network of narrow channels connecting the Amazons with the Tocantins. The tides ebb and flow in these channels but the south-westerly current predominates, so that a portion of Amazonian water reaches the Tocantins. The channels are cut through a wide stretch of alluvial land which is directly continuous with the flood-plain of the Amazons. Marajó itself is almost entirely composed of or covered with alluvial deposits. The eastern and northern parts of the island are occupied by *varzea* meadows, while the southern and western portions are almost continuous swamps, noted for their rubber trees and for their deadly fevers. The whole island abounds in shallow lakes, and it is cut up by hundreds of small creeks and channels, the haunts of alligators and serpents. Only along the eastern and southern edges there are some narrow strips of *terre-firme*, true rocky land raised well above the highest floods. The first settlers took advantage of these little dry spots, building their houses on them and sheltering their cattle there when the meadows were overflowed. Breves and other villages owe their situations to these *torrões*.

From the highlands of Guiana a number of rivers flow down, with many rapids and falls, to the Amazons. None of these streams have been explored to their sources, and most of them are known only near their mouths, where they flow across the

[1] In Tupy, a wet land or swamp.

region which I have called a lower terrace. As soon as they enter this region the rapids cease, and immense flood-plains spread out on both sides. Besides the fact that these flood-plains are out of all proportion to the rivers, they are remarkable for the extreme irregularity of their borders. Every little stream which enters the main affluent passes through a flood-plain of its own, often five or six miles broad, though the stream itself may be hardly as many feet across. Crooked bays of *varzea* extend far into the mainland; numberless islands of *terre-firme* are scattered over the flood-plain; and the most conscientious map-maker who attempts to unravel this tangle is likely to give up in despair. The irregularity generally increases toward the Amazons, where the alluvial land of the tributaries spread out broadly until it is lost in the Amazon flood-plain.

Three great tributaries—the Tapajós, Xingú and Tocantins—flow down over the southern table-land from the center of South America. Geographically it should be said, the Tocantins cannot be regarded as a tributary of the Amazons; its mouth, called the Pará river, receives a portion of Amazonian water, but it opens into the Atlantic and is separated from the main mouth of the Amazons by Marajó. Physically the three rivers resemble each other closely. They are all clear-water streams, flowing down, with many rapids, to a point about 150 miles from their mouths, where the rapids cease, and the rivers gradually expand into quiet lakes. The lakes are bordered by bluffs, edges of the table-land and continuous with those which border the southern side of the Amazonian flood-plain. In their lower portion these lakes are from seven to ten miles wide and very deep; they have hardly any current, but rise and fall with the tides as regularly as the sea. At their northern ends they are suddenly contracted by the Amazonian flood-plain, and here they receive Amazonian water through narrow channels or *furos*. The *furos*, where they open into the lakes, are still bringing in Amazonian sediment, and they have thus pushed their mouths far into the clear water. The Tapajós and Xingú finally reach the Amazons through embouchures less than half a mile broad—about the average width of these rivers near their lower falls.

Some smaller rivers which enter the Amazons from the south have more or less muddy waters, and these have filled up their valleys with sediment. The flood-plains thus formed are bordered

by bluffs precisely like those along the Lower Tapajós and Xingú. It is evident, then, that these muddy rivers, in their lower courses, were once expanded into lake-like reaches, similar to those of the clear-water tributaries.

If we now return to the northern side of the Amazons we shall find at least one clear-water tributary, the Trombetas, which is lake-like along its lower courses. But as the river here passes through low *terre-firme*, the bluffs are wanting; the borders are extremely irregular, and numerous small lakes open into the main one on either side; islands or peninsulas of low, rocky land separate these lakes from the river, and smaller islands are cut off in the lakes or in the river itself.[1] In fact the whole corresponds precisely to the irregular flood-plains of the other northern tributaries. The latter, being muddy, have filled up the lakes and channels with sediment, and they now wind about in broad alluvial tracts, the borders of which seem to be inextricably mingled with the *terre-firme*.

I believe it can be shown that all the main tributaries of the Lower Amazons are, or have been, lake-like in their lower courses. The question then arises: Were these lakes produced by a damming back of the tributaries by Amazonian silt, so that they filled up their valleys? I think not. No doubt the alluvial land, closing the mouths of the lakes, has tended to raise their waters; but the flood-plain of the Lower Amazons is everywhere so near the level of the sea that this uplift cannot have been very great. The tides, which are felt on the main Amazons as far as Obidos, are very apparent on the Lower Xingú and Tapajós; Bates noticed them on a secondary tributary of the latter river nearly six hundred miles from the ocean. It is well, also, to note the similarity of the Tapajós and Xingú to the Tocantins, which opens broadly into the sea and cannot owe its lake-like lower course to any damming back of the waters.

Having reached this point it requires but little imagination to apply the same reasoning to the Amazons itself; to look upon the flood-plains as a filled-up sea or great bay, with many branches, which now form the flood-plains or tidal-lakes of the tributaries. Let us go back in imagination to the period before this sea was filled up and map out the Amazonian system as it then was.

Stretching eight hundred miles west-south-westward from the

[1] I owe these notes on the topography of the Trombetas to Professor O. A. Derby.

Atlantic, a narrow estuary bay or inland sea divided the northern part of the South American continent. The water in the eastern portion was clear and salt; heavy tides swept up the long sand-beaches and dashed against the cliffs of clay and conglomerate. In general the channel was clear, but here and there little rocky islands added to the picturesque beauty of the shores. On the northern side a number of blue mountains could be seen; spurs and outlyers of the table-land which stretched down from the Guiana chain. To the south a line of bluffs fronted the water, the northern edge of another great table-land. The Tapajós, Xingú, Trombetas and many smaller rivers flowed into the Amazonian sea through long branch estuaries or tidal bays. Some of these streams were muddy and tended to fill up their mouths; others preserved clear, deep channels.

Just at its mouth, on the southern side, the great estuary met a lesser one, now the Lower Tocantins, and its outlet, the Pará. The two bays were partly separated by a string of low sandy islands and reefs, like those now fronting the sounds along the south-eastern coast of the United States. These reefs now form the *torrões* along the southern and eastern side of Marajó.

In the Amazonian bay the greatest extent of brackish or fresh water was towards the western end, where the water was shallow and much obstructed by islands. Islands and shallows owed their existence to, and were yearly being built up by, the Solimoens and Madeira, which here poured in their floods of muddy water. The mouths of these rivers formed two branches at the head of the bay; a third branch marked the outlet of the Negro, which, as it brought down little sediment, preserved a wide and clean channel.

Then, as now, the trade-wind blew in freely from the Atlantic, and the climate was equable and moist. The plants and animals of the shores were probably similar to those which now inhabit the highland, but the great estuary formed an impassable barrier to many species, and the Guiana fauna and flora were more sharply divided from those of Brazil. The estuary itself was inhabited principally by marine forms of fishes, Crustacea and Mollusca; only at the western end, where the larger rivers emptied in, brackish-water forms prevailed.

Gradually the alluvial land at the head of the bay extended eastward, filling up the estuary with islands. As this eastward

movement went on, the branch estuaries were blocked up at their mouths by the islands which formed in front of them. Where the branch received a muddy tributary it also was filled up; but the clear-water tributaries, like the Tapajós, Xingú and Tombetas, brought down no sediment, and their estuaries, closed at the mouths, assumed the form of lakes.

In this way the whole of the Amazonian flood-plain has been built up. Passing now a step farther back it is easy to see that the flood-plains of the Solimoens and Madeira were formed in the same way. But the vast extent of this alluvial land on the Upper Amazons seems to indicate a widening of the great bay at its upper end; a kind of inland sea connected with the ocean towards the east by a comparatively narrow strait.[1] This sea, at the period of which I am speaking, had no connection with the Orinoco valley, for the Amazonian flood-plain is now separated from that river by rocky *terre-firme*, indicated by the falls of the Orinoco and Negro. Several large rivers, flowing down from the Andes, emptied into the sea near its western end, and eventually transformed it into a river by filling its bed with sediment. These Andean torrents still exist as the Huallaga, Ucayale, Napo, Tigre and extreme Upper Amazons.

Such a branched estuary bay as I have described could only have been formed by the subsidence of land over a great area, and the encroachment of the sea on the valleys of some former Amazons and its tributaries. This subsidence must have taken place subsequently to the deposition of the clays and sandstones which form much of the *terre-firme* along the Lower Amazons. For the very tributaries on which the above arguments have been based flow through valleys which they have cut in the clays and sandstones themselves. It appears probable, also, that the period of subsidence was anterior to the formation of the *Tabatinga* clays on the Upper Amazons.

For the sake of clearness I have described the silting-up of the valley as occurring during a period of repose subsequent to the subsidence. But it is quite possible that the subsidence and filling up were, in part, contemporaneous. The Upper Amazonian sea may have had its outlet through a Lower Amazonian river

[1]It may be, however, that this widened flood-plain is due to the extreme shallowness of the valley of the upper river; the Amazons, dammed back somewhat by the accumulations below, would tend to spread out on either side and build up its own bed.

which, by the sinking of the land, was changed to an estuary while the sea was being filled with sediment. These questions must be settled by a more careful study of the Upper Amazons and its tributaries and especially of the Madeira and Negro. But whatever the changes may have been it is certain that the Amazonian river system is much older than the period of subsidence of which I have spoken. The slow pulsations of the earth have sent many throbs to this equatorial region; centuries of subsidence have been followed by centuries of upheaval, and these again by depression; river has become sea and sea has passed into river and estuary again and again since first the rains and springs united to form an infant Amazons. We have some glimpses of this older history, but as yet geological exploration on the Amazons is too new to give us any very clear sequence of events.

It appears certain that the immense low plain of the Upper Amazons was occupied by a Tertiary sea, older and much larger than the one which has been described above. Tertiary marine shells have been found at several points on the Marañon and Solimoens, and the *Tabatinga* clays which contain these shells extend far up the Japurá and Purús. The upheaval which placed these clays beyond reach of the river waters may have taken place long previous to the estuary depression, and many changes may have intervened. It appears probable that this Tertiary sea opened into the Atlantic through what is now the valley of the Orinoco, and that the Cassiquiare, which at present unites the two great river-systems, may correspond to one side of the strait or channel. It has been supposed that the sea had two outlets, one by the Orinoco valley and the other by that of the Lower Amazons, and that the Guiana highland formed a great island between them. Of this I think there is no sufficient proof. On the Lower Amazons the bluffs between the Tapajós and Tocantins and the table-topped hills of the northern side are formed of clays and ferruginous sandstones; but it is yet to be shown that these are continuous with the Tertiary formations of Tabatinga. Similar clays and sandstones occur all through Central and Eastern Brazil and in the Argentine Republic, but they belong to many different ages; no one who has studied geology in Brazil will be likely, on mere lithological grounds, to unite formations a thousand miles apart. The clays of the Lower Amazons, then,

may be older or newer than those of the Marañon, and the Tertiary sea which left the shells at Pebas may or may not have been united with the ocean by a Lower Amazonian strait. Some facts in geographical distribution lead me to suppose that Guiana was then united to Central and Southern Brazil. In that case the Amazons may possibly have flowed westward into the Tertiary sea from some high land farther east.

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HIBERNATION OF THE LOWER VERTEBRATES.[1]

BY AMOS W. BUTLER.

IN a recent article in *Science* (Vol. IV, No. 75, pp. 36–39) Dr. C. C. Abbott gave the results of his observations of the hibernation of some of the lower vertebrates.

I have for several years, as opportunity offered, noted my observations in this line, and while my experience in some respects has been similar to that of Dr. Abbott, I feel that the results I have obtained may be appreciated by others similarly interested.

The climate of New Jersey and Southern Indiana is much the same; this fact will lead us to expect somewhat similar results from our observations.

The common box tortoise, called also "land tortoise" and "terrapin," according to locality, hibernates regularly in Southern Indiana. It frequents the drier woodland, partially overgrown with underbrush. It enters the ground in the latter part of September or early in October to a depth not exceeding a foot, the average being from eight to ten inches.

A few years ago, in March, I was burning over a track of woodland on which were a number of brush piles; when the fire burned out I passed by where some of the brush piles had been and noticed that the ground appeared to have been torn up as though a charge from a shot gun had been fired into it. Examination, in several instances, revealed the fact that the work had been done by tortoises. The heat having penetrated to the depth of their winter quarters and aroused them from their winter's sleep, they now sought the surface and the cause of their sudden awakening.

The day being quite cool I placed them in a beaten road which

[1] Read before Section of Biology A. A. A. S., at Philadelphia meeting, 1884.

passed through the woods and awaited further proceedings; they appeared to realize that they had entered upon their summer career too soon, and a few moments saw them all safely buried beneath neighboring brush piles and bunches of leaves.

The box tortoise emerges from its winter quarters late in April or early in May.

Mud turtles, including all the river and pond turtles, hibernate in this locality, but there will, no doubt, be occasional exceptions found to this rule.

The "soft-shelled" turtles burrow deep into the mud, while their "hard-shelled" relatives are not so susceptible to climatic changes, and their wintering places are not at such a depth.

I have under my charge a water-power canal fourteen miles long, parts of which are thickly populated by turtles. In the winter time while making repairs, "hard-shelled" turtles are often found at a depth of four to twelve inches beneath the earth in the bed of the canal; when one is found we feel quite confident of finding from two to four companions near by. Many turtles frequent little coves along the banks of the canal, where the water is from two to three feet deep; these indentures are generally made by muskrats; in repairing the destruction they cause as many as three or four "hard shells" are sometimes taken from their muddy quarters.

The White-Water rivers are very clear in winter, enabling one to examine even their deeper portions to advantage. I have never been able to hear of an instance where a turtle has been seen even in the deepest water; besides, the deeper pools are seined almost every winter, and I have been unable to learn of a turtle ever having been drawn out in a seine at that time of the year.

My fellow-worker, Mr. E. R. Quick, gives me some notes which are exceptions to the rule of hibernation just mentioned. He says: "I have known mud turtles (*Aromochelys odoratus* Latreille) to leave ponds which became dry in the winter time and go to the river near by. In the winter of 1874–5 I saw the tracks of a large turtle in the snow leading from the bed of a pond which had become dry, to the river a short distance away. I think the tracks were made while the snow was melting."

The above instances appear to indicate that the act of hibernation is voluntary to a certain extent. I have found "hard-shelled" turtles that had been left at some distance from the river by win-

ter floods; they appeared dead, but when brought to a fire became quite active. "Soft-shell" turtles always die when thus thrown out by rises in the river in winter.

Our more tender fish hibernate, but there are many hardy species that frequent the deeper pools of our rivers and are caught in large numbers by means of seines and nets let down through the ice.

The species most commonly caught in this manner are quill-backs (*Carpoides velifer* Rafinesque, and *C. cutisanserinus* Cope), white sucker (*Catostomus teres* LeS.) and the "hog sucker" or "molly-hog" (*C. nigricans* LeS.). The latter is apparently the hardiest of our fishes, being found in winter in shallow water of from six to twelve inches in depth. When the ice is three or four inches thick and clear, many "molly hogs" are caught in the following manner: The fisherman walks slowly along the edge of the river on the ice, keeping a close lookout for fish, which will be seen just beneath the ice; a heavy blow with an axe immediately above where they are either kills or stuns them; hastily cutting a hole in the ice the fisherman throws his fish out and proceeds in search of another. By this method, some winters, great quantities of fish are caught.

The common toad regularly hibernates, in sandy soil burrowing to the depth of eighteen inches, in clayey ground the average depth attained is about eight inches. They frequent gardens and are often found in their burrows in autumn by the gardener when burying garden produce and apples. In early spring they are frequently thrown out by the spade during early gardening, and in a few moments hop off apparently without impediment.

Frogs are, at times, found some distance from water, passing the winters burrowing in damp places.

Early last spring when clearing out a cellar window two leopard frogs (*Rana halecina* Kalm) were found burrowed beneath the accumulation of the past year. The weather was quite cool and the frogs appeared to be dead, but when taken into a warm room they soon revived and began croaking. The locality where these frogs were found is on a ridge about seventy-five feet high and over three hundred yards from the river.

As a rule newts and salamanders do not enter the ground but spend the winter in springs and beneath leaves and logs in the damper woods. I have found them in winter, when the springs

were not frozen, to be quite active. I have taken the common newt on several occasions in damp woods, under logs, when they appear to be frozen, but when placed in the sun or held in the hand a short time would revive. Early in March the woodland ponds of this vicinity teem with salamanders of different species.

In this part of the Ohio valley, as a rule, tortoises, turtles, toads and frogs are found hibernating; on the other hand the newts, salamanders and many species of fish do not enter a torpid state.

Exceptions to these rules will doubtless occasionally be noticed, but from the present state of our knowledge of the life-histories of these animals they hold good.

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THE AMBLYPODA.

BY E. D. COPE.

(Continued from page 1202, Vol. xviii.)

Dinocerata.

IN this suborder we have a series of mammals which are in some respects the most remarkable that have ever existed. This is true whether we regard the bizarre appearance of their skulls, their dentition, so weak when compared with the bulk of their bodies, or the insignificant size of their brain. We only know them as yet from the Bridger or Upper Eocene formation of North America, with a species possibly from the Wasatch or Lower Eocene.

The characters of this suborder have been already pointed out (Vol. xviii, p. 1121). The differences from the Pantodonta are well marked, but the resemblances are such as to render it impossible to refer the Dinocerata to a different order. Their strong resemblances to the Proboscidia are generally admitted, but the few characters which distinguish them are of the first importance. These are, first, the very small size of the brain, especially of the cerebral hemispheres; and second, the double distal articulation of the astragalus, where the facet for the cuboid bone is nearly as large as that for the navicular.

Within the above definition there is room for much variation, which, however, the known genera do not display. They agree in various points of minor importance. Thus there is no sagittal

crest of the skull, the temporal ridges being lateral, and there is a great transverse supraoccipital crest. These crests are more or less furnished with osseous processes or horns. The middle pair of these (Fig. 29) consists in part of the maxillary bone, and stands in front of or over the eye. The nostrils are well roofed

FIG. 24.—*Loxolophodon cornutus* Cope, skull from right side, one-eighth natural size. From the Bridger bed of Wyoming. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol. III. Lower jaw restored from Osborn, Memoir on Loxolophodon and Uintatherium. From individual represented in Pl. I.

over by the nasal bones. There is always a diastema behind the canine tooth in both jaws. There is less difference between the premolar and molar teeth in the known genera than in the Pantodonta, and they all have the same pattern, although the origin of the pattern may be different in the two series. Thus in the upper

jaw the crowns of the molars support two oblique cross-crests, which unite to form a V with the apex inwards. There is sometimes an internal cusp or tubercle. The inferior molars consist essentially of an outer V and a heel; the true molars differ in having the heel a little larger and more recurved on its posterior border, but it does not rise into a transverse crest as in the Coryphodontidæ. Mr. Osborn shows that the inferior incisors in Loxolophodon are compressed and two-lobed.

The known genera agree with the typical Proboscidia in the shape of the scapula with posterior expansion and apical acumination; in the flat carpal bones; in the absence of pit for round ligament of the femur; in the flattened great trochanter, contracted condyles, and fissure-like intercondylar fossa of the same bone. Also in the short calcaneum or heel bone, which is wider than long, and rough on the inferior face; in the five digits on both feet, and the wide peduncle and iliac plates of the pelvis and lack of angular production of the latter beyond the sacrum.

FIG. 25.—*Uintatherium mirabile* Marsh, bones of feet, two-ninths natural size. Upper figure anterior, lower figure posterior feet. From Bridger beds of Wyoming. Slightly altered (lunar bone) from Marsh, *Am. Journ. Sci. Arts*, XI, Pl. VI.

In spite of these resemblances, the Dinocerata are at one side of the line of descent of the mastodons and elephants (see Vol. XVIII, p. 1121, for phylogeny of the hoofed Mammalia). This is indicated not only by the structure of their feet, but by that of their teeth, which, as I have shown, constitute a survival of the tritubercular type which had been left behind by all other cotemporary ungulates, and only survived in the flesh-eaters of the Bridger epoch.

The resemblance of the feet to those of Coryphodon may be readily seen by comparing Fig. 25 with Figs. 1–2 (p. 1110, Vol. XVIII). The characters of the component parts are quite identical.

Professor Marsh has given us a figure of the cast of the brain chamber of the *Uintatherium mirabile* Marsh. It displays most striking peculiarities. These are: (1) The small size of the hemispheres; (2) the difficulty of distinguishing the cerebellum from the surrounding parts; (3) the large size of the olfactory lobes (Fig. 26). In all these respects there is a great resemblance to the brain of Coryphodon (Fig. 13). The hemispheres pass into the olfactory lobes by a gradual contraction of their outlines. They rise higher than, and then descend posteriorly towards the mesencephalon and cerebellum. The latter parts, as in Coryphodon, are not distinguished in the cast. The hemispheres are not convoluted, nor is there any sylvian fissure, according to Marsh's figures. This brain, as remarked by Marsh, is the most reptilian among the Mammalia. One of the strongest confirmations of this statement, is the small size of the cerebellum.

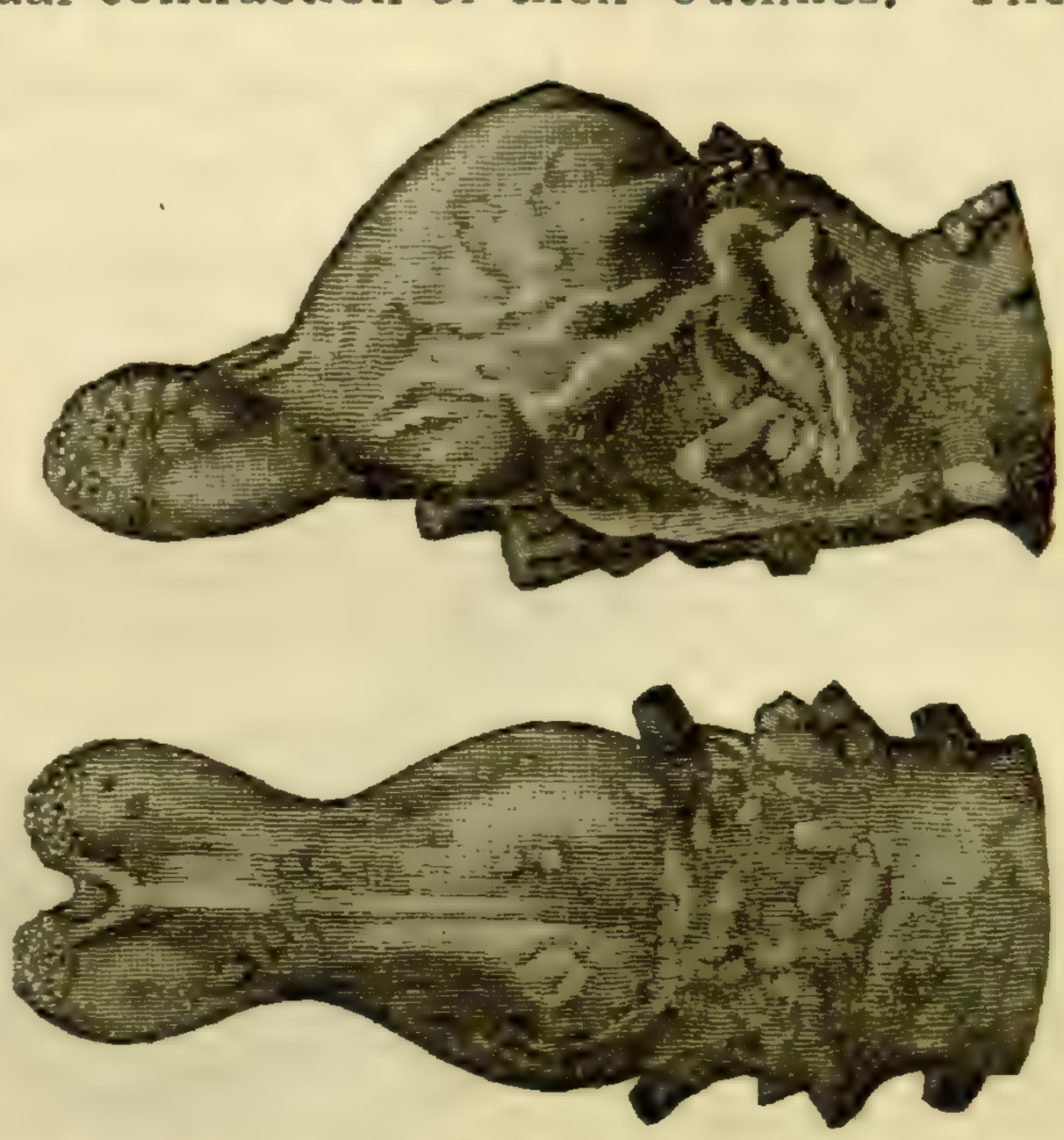


FIG. 26.—*Uintatherium mirabile* Marsh, brain one-third nat. size. From Marsh, *Amer. Jour. Sci. Arts*, Vol. XI, Pl. IV.

Owing to the imperfect character of the material which I have had the opportunity of examining, it is not possible to state the number of genera with absolute certainty. There are certainly three of these, and probably four. So far as present knowledge goes, they pertain to one family, which I have called the Eobasiliidæ. The three genera mentioned differ in the forms of the mandible; the fourth has certain cervical vertebræ of a peculiar form, but the form of the mandible is unknown. I can only contrast the genera as follows:

A. Mandible unknown.

Certain cervical vertebræ short and flat, as in Proboscidia .....*Eobasileus.*

AA. Symphysis of mandible with four teeth on each side.

a. Mandible without inferior expansion.

Cervical vertebræ not very short; three premolars; lower incisors bilobate, *Loxolophodon.*

aa. Mandible with anterior inferior expansion.

Cervical vertebræ not short; three premolars.....*Octotomus.*

aaa. Mandible expanded below, its entire length.

Cervical vertebræ unknown; four lower premolars; four incisors, simple, *Bathyopsis.*

AAA. Symphysis of mandible with three or two teeth on each side.

Mandible with very narrow symphysis.....*Uintatherium.*

In probably a majority of the species the lower jaw has a deep flange on its inferior border below the canine teeth, which serves, like the corresponding structure in the saber-tooth tigers, to pro-

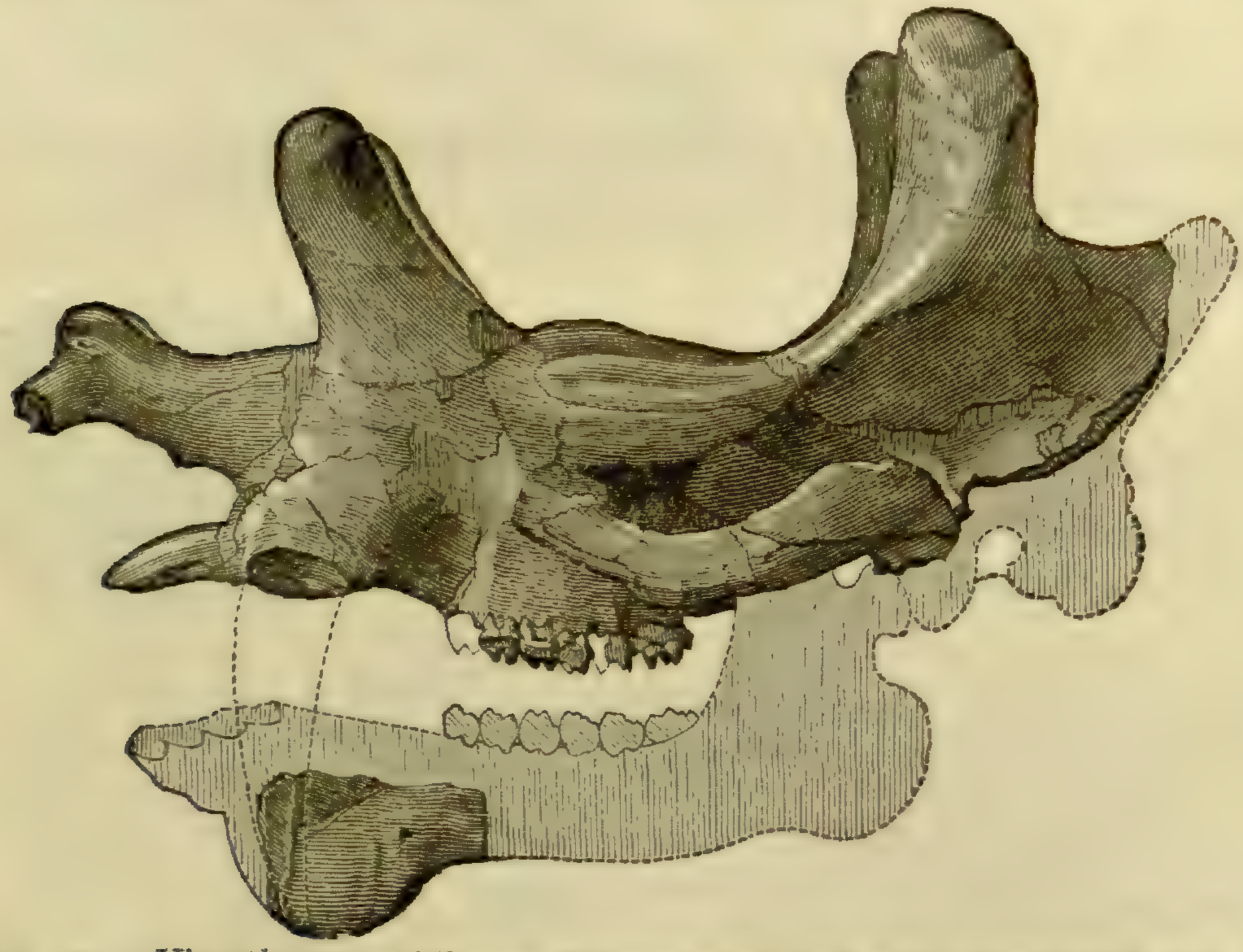


FIG. 27.—*Uintatherium leidianum* Osborn, skull left side, one-eighth nat. size; rom the Bridger beds of Wyoming. From Osborn, Memoir on Loxolophodon and Uintatherium.

tect the long superior canine tooth from lateral blows and strains (Fig. 27). In Bathyopsis this inferior expansion includes almost the entire inferior border of the ramus, giving an outline something like that of Megatherium (Fig. 35).

The genus Eobasileus was established on a species (*E. pressicornis* Cope) which is represented by a considerable part of the

skeleton, but without cranium or teeth; hence most of its characters remain unknown. The very short cervical vertebra which belongs to it serves to distinguish it from other genera. A second specimen (*E. furcatus*) found near the first, may belong to it; it includes a fragmentary cranium, but unfortunately no cervical vertebræ. Its introduction into this genus is therefore purely arbitrary.

The typical species is of large proportions, only second in size to the *Loxolophodon cornutus*. Its limbs were more slender in their proportions. It is in this species that I find much evidence in favor of the presence of a proboscis of greater or less length. Should several of the other cervical vertebræ have been as short as the one preserved, it is evident that the animal could not possibly have reached the ground with a muzzle so elevated as the long legs clearly indicate. In the species of the other genera, where the cervical vertebræ are longer, this may have not been the case.

The bones of this species were discovered by the writer in an amphitheater of the bad lands of the Washakie basin, known as the Mammoth buttes, in Southwestern Wyoming. They were in greater or less part exposed, lying on a table-like mass of soft Eocene sandstone. A description of this remarkable locality is given in the *Penn Monthly Magazine* for August, 1872.

The *Eobasileus furcatus* is principally represented by a skull in which the most important features have been preserved. As in all the species of Uintatherium in which the horns are known, these appendages stood in front of the orbits, it is probable that such was the case in the *Eobasileus furcatus* also. The muzzle is materially shorter and more contracted, and the true apex of the muzzle was not overhung by the great cornices seen in *Loxolophodon cornutus*. The occipital and parietal crests are much more extended in this species than in the *L. cornutus*, so that in life the snout and muzzle had not such a preponderance of proportion as in that species. All the species of this genus were rather rhinocerotic in the proportions of the head, although the horns and tusks produced a different physiognomy.

The known species of Loxolophodon Cope, are the largest of the order. Three species are known to be distinct: the *L. cornutus* Cope, *L. galeatus* Cope, and *L. spierianus* Osborn. They differ in the form of the horns and in the shape of the occiput.

The cranium in this genus is elongated and compressed. The muzzle is posteriorly roof-shaped, but is anteriorly concave and flattened out into a bilobed protuberance which rises above the extremity of the nasal bone. This extremity is subconic and short and decurved. A second pair of horn-cores stands above the orbits, each one composed externally of the maxillary bone, and internally of an upward extension of the posterior part of the nasal. Behind this horn the superior margin of the temporal fossa sinks, but rises again at its posterior portion, ascending above the level of the middle of the parietal bones. The occipital rises in a wall upwards from the foramen-magnum and supports, a little in front of the junction with the superior and posterior crests bounding the temporal fossa, a third horn-core on each side.

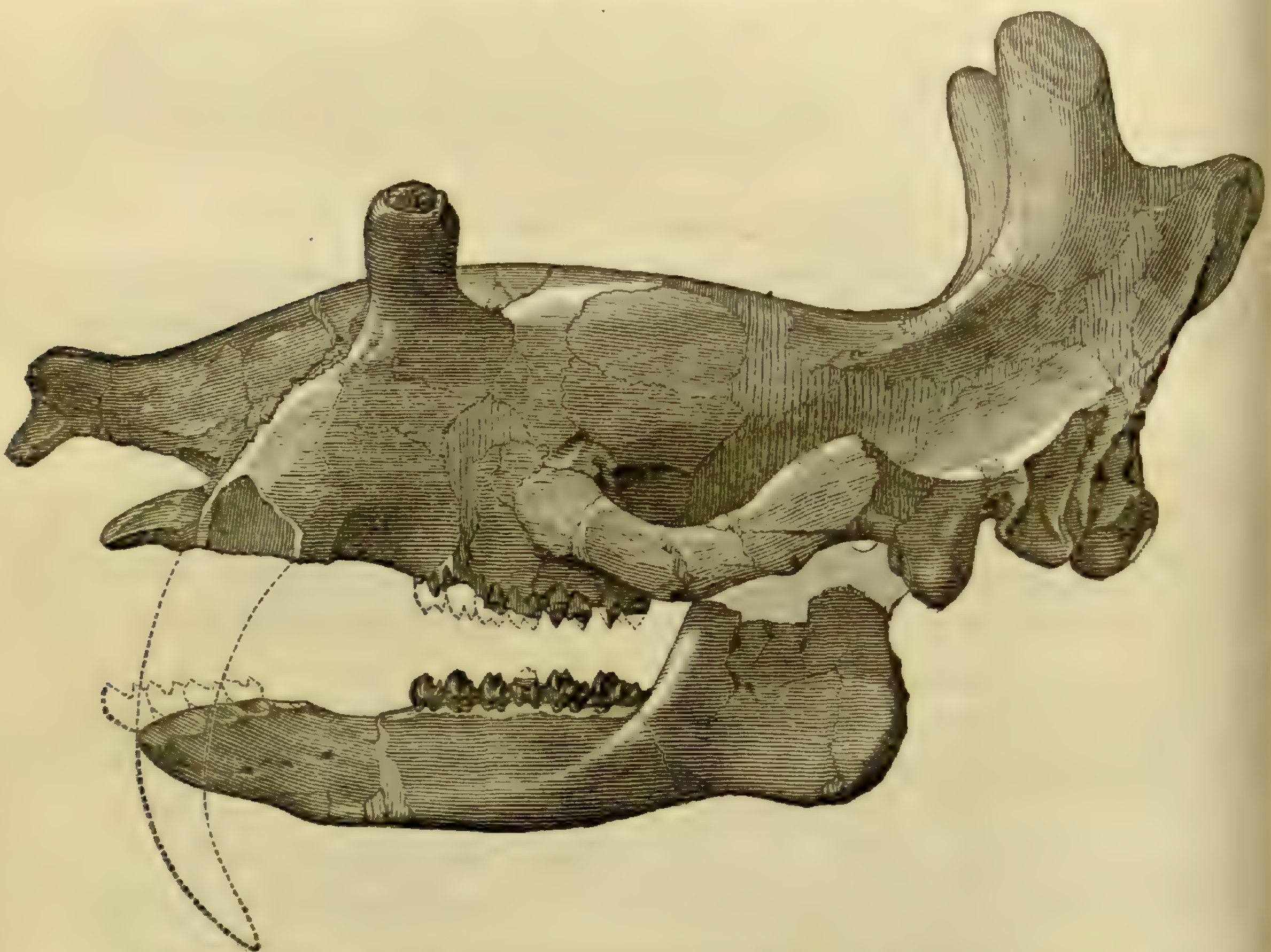


FIG. 28.—*Loxolophodon spierianus* Osborn, skull from left side, one-eighth natural size; from the Bridger beds of Wyoming. From Osborn, Memoir or Loxolophodon, etc.

The three species may be distinguished as follows:

Median horns triangular in section, with internal tuberosity, and above orbits; occiput narrow.....*L. cornutus.*
Median horns subquadrate in section without internal tuberosity; occiput and nasal tubercles wide.....*L. galeatus.*
Median horns subround and without tuberosity, in front or orbits; occiput and nasal tubercles narrow.....*L. spierianus.*

The *Loxolophodon spierianus* Osborn, was as large an animal as the two others, and had a very elongate skull with weak horns and narrow, high occiput. Its median horns are situated well anterior to the orbit, and its zygomatic fossa is remarkably small. It was discovered by the Princeton scientific exploring party at the same locality that produced the other species, viz., the Mammoth buttes of Southwestern Wyoming (Fig. 28).

In the *L. cornutus* and *L. galeatus* the tuberosities which stand

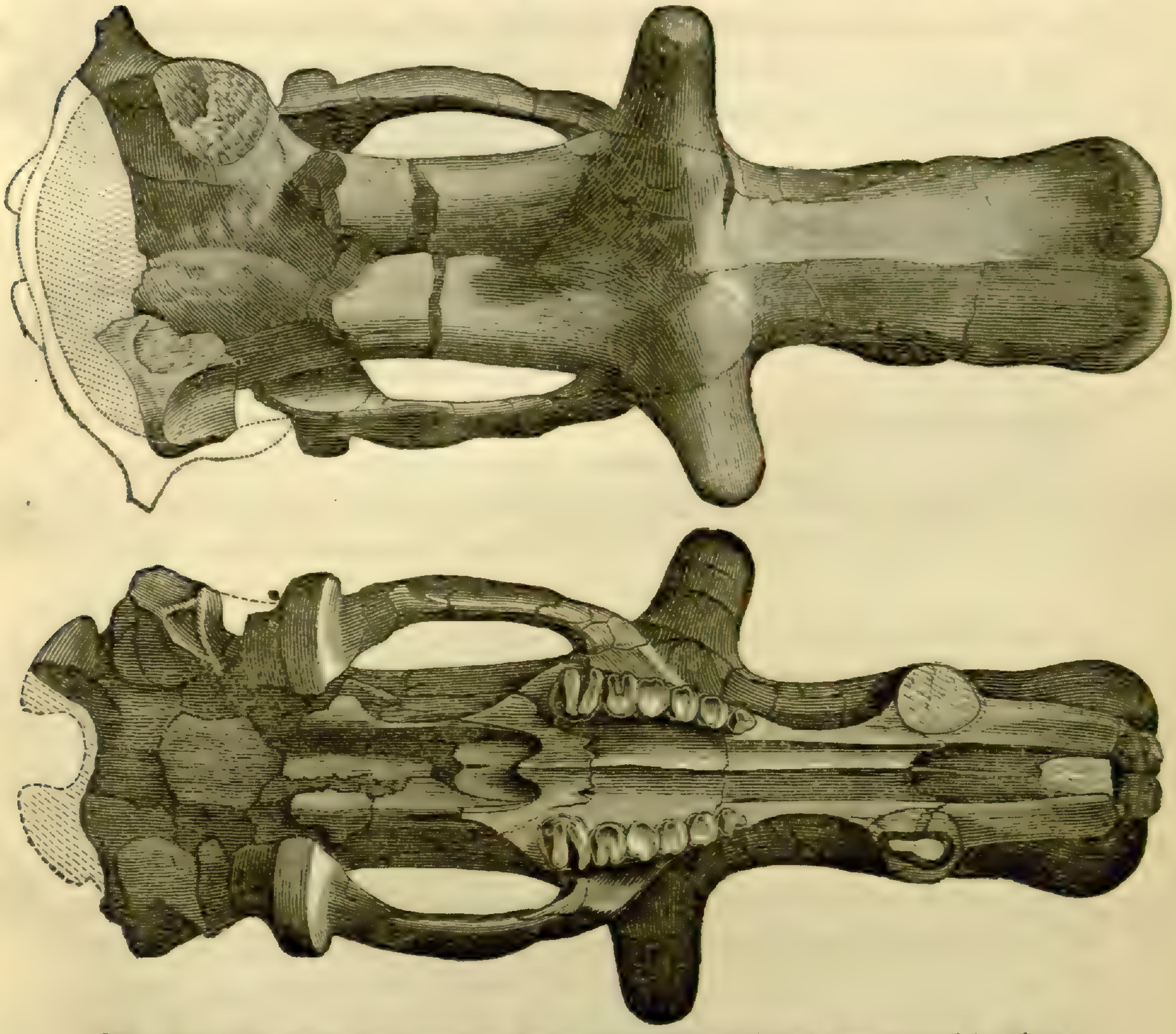


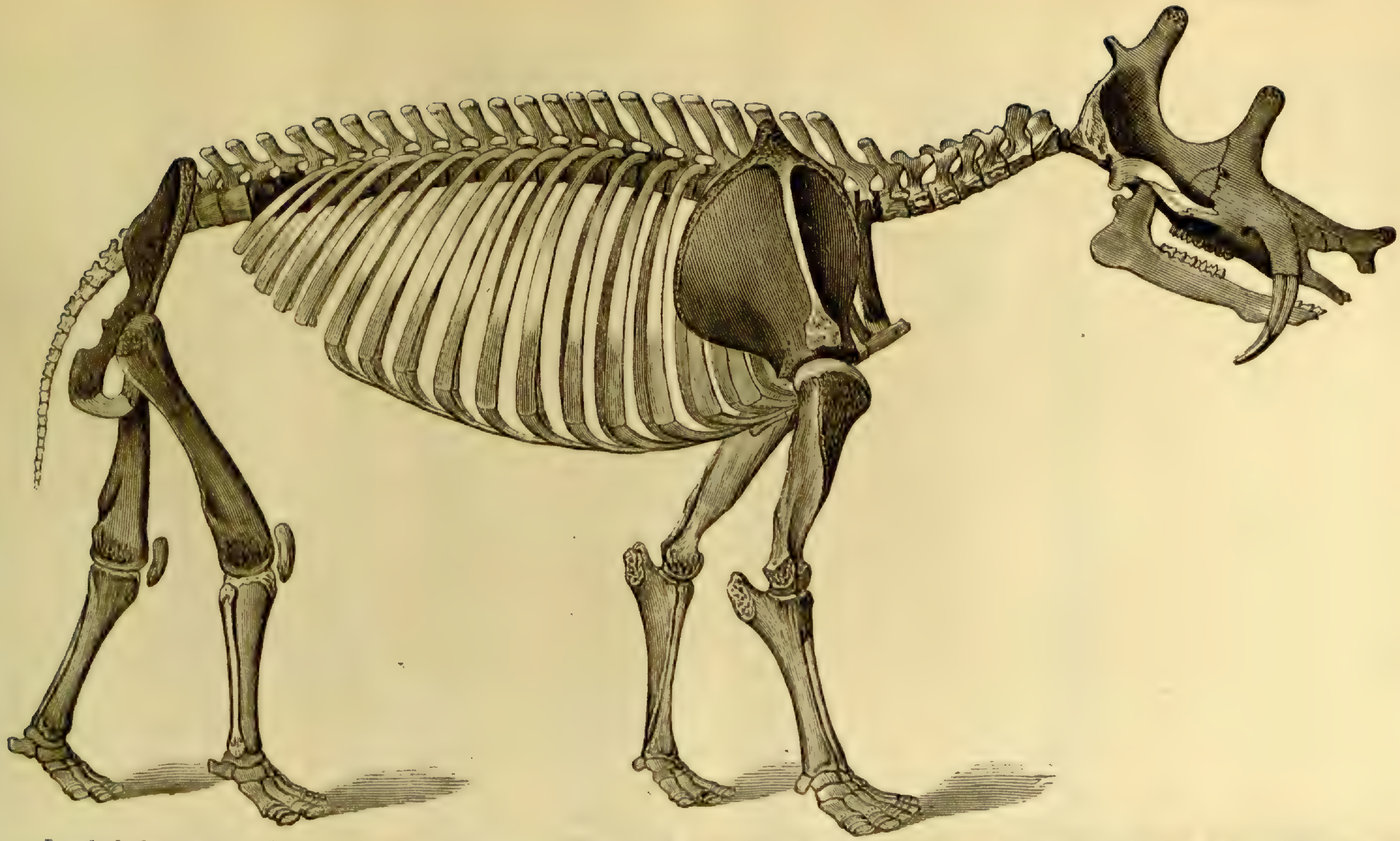
FIG. 29.—*Loxolophodon cornutus* Cope, skull of individual represented in Plate I, one-eighth nat. size. Upper figure superior surface; lower figure inferior surface. From Bridger Eocene of Wyoming. Original, from Report U. S. Geol. Survey of Terrs., F. V. Hayden in charge, Vol. III. Owing to distortion of the specimen behind, the occipital condyles are too far apart in the figure.

near the free extremity of the nasal bones are greatly developed, so as to represent a pair of cornices projecting upwards and forwards over the narrow apex of the bones (Fig. 24). From above, the end of the muzzle in those species has a bilobate outline. They differ from each other materially in the form of the middle pair of horns.

Mr. Osborn, of Princeton, has published a description of the lower jaw and teeth of a species of Loxolophodon, which he identifies with the *L. cornutus*, which was derived from the locality and horizon of the species above mentioned (Fig. 8). They show that the descending flange of Uintatherium and Bathyopsis is only represented by a convex ridge on each side of the symphysis. They point out the characters of the dentition, which are remarkable. The molars much resemble those of Bathyopsis. The canines and incisors are alike in form, and in a continuous series. The crowns are compressed so as to be extended anteroposteriorly, and are deeply emarginate, so as to be bilobed, the lobes with subacute edges. This form of incisors is unique, resembling only remotely the large median incisors of certain Insectivora (Fig. 30). Resemblance to mammals of the same type may be traced in the molar teeth.

FIG. 30.—Incisor and canine teeth of left side of lower jaw of Loxolophodon, one-fourth natural size. From Osborn.

We may ascribe to the *Loxolophodon cornutus* form and proportions of body similar to those of the elephant (see Plate 1). The limbs, however, were somewhat shorter, as the femur (Fig. 31) is stouter for its length than in the *E. indicus*. It was intermediate in this respect between the latter species and the species of Rhinoceros. The tibia is relatively still shorter. The tail was quite small. The neck was a little longer than in the elephants, but much less than in the rhinoceroses; the occipital crest gave attachments to the *ligamentum nuchæ* and muscles of the neck, which must needs have been powerful to support the long muzzle with its osseous prominences, and to handle with effect the terrible laniary tusks. The head must have been supported somewhat obliquely downward, presenting the horns somewhat forward as well as upward. The third or posterior pair of horns towered above the middle ones, extending vertically with a divergence when the head was at rest. The posterior and middle pair of horns were no doubt covered by integument in some shape, but whether dermal or corneous is uncertain. Their penetrating foramina are smaller than in the Bovidæ. The cores have remotely the form of those of the *Antilocapra americana*, whence I suspect that the horns had an inner process or angle as in the



Loxolophodon cornutus Cope, restored to $\frac{1}{27}$ nat. size. The darkly shaded portions are those in my possession; the feet and caudal and cervical vertebræ are restored after Marsh (Uintatherium); the lower jaw after Osborn. Original, from AMERICAN NATURALIST, 1882, p. 1029.

prong-horn at present inhabiting the same region. The nasal shovels may have supported a pair of flat divergent dermal tuberosities, but this is uncertain; they are not very rugose.

The elevation of the animal at the rump was about six feet, distributed as follows, allowance being made for the obliquity of the foot:

	Inches.
Foot	4.50
Tibia	20.50
Femur	31.75
Pelvis	16.00
	72.75

The anterior limbs were stouter than the posterior, judging

FIG. 31.—*Loxolophodon cornutus* Cope, femur of individuel represented in Pl. I, one-ninth nat. size. From Bridger beds of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., III, F. V. Hayden in charge.

from the proportions in various species, and were no doubt longer if of the Proboscidian character. This would give us the hypothetical elevation at the withers:

	Inches.
Leg	61.00
Scapula (actual)	21.00
Neural spines (extremities)	7.00
Or 7 feet 5 inches	89.00

These measurements are made from the plantar and palmar surfaces, allowance being made for the pads.

FIG. 32.—*Loxolophodon cornutus* Cope, pelvis of individual represented in Pl. I; from front; one-eighth nat. size. Original.

The obliquity of the anteroposterior axis of the anterior dorsal vertebra indicates that the head was posteriorly elevated above the axis of the dorsal vertebræ. Owing to the lack of cervical ver-

tebræ, the length of the neck cannot be determined. It may have been short, as in the *Eobasileus pressicornis*, or longer, as in the species of Uintatherium. The indications derived from the bones of the muzzle point to the attachment of a heavy upper lip. The numerous rugosities of the posttympanic and mastoid regions indicate the insertions of strong muscles. Some of these may have been adductors of large external ears.

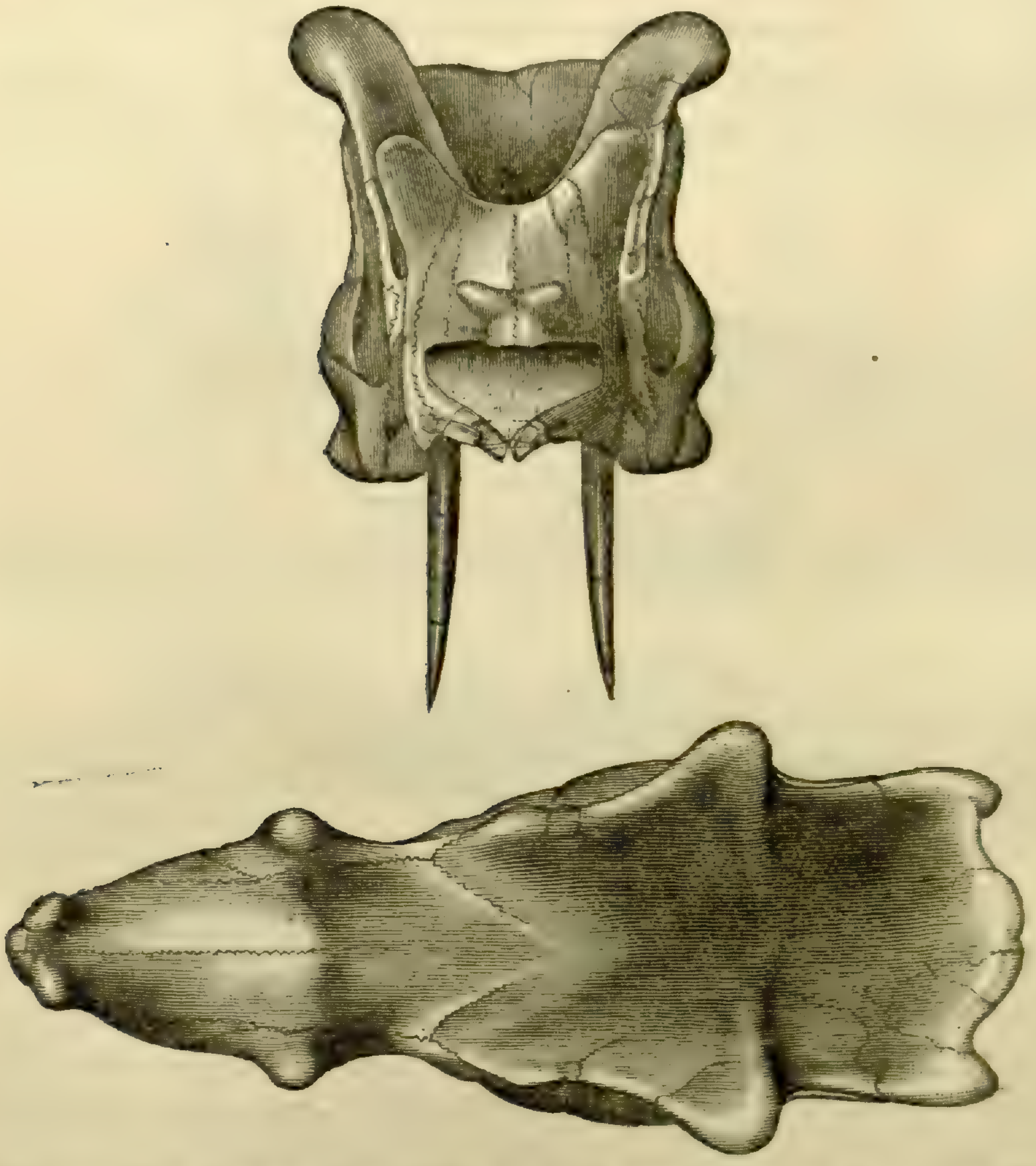


FIG. 33.—*Uintatherium mirabile* Marsh, skull, one-eighth nat. size; upper figure from front, lower figure from above. From Bridger Eocene of Wyoming. From Marsh, *Amer. Jour. Sci. Arts*, XI, Pl. II.

The inferior incisor teeth have no adaptation for cutting off vegetation. The mental foramen is small, but the small nutrient artery thus indicated is not adverse to belief in a prehensile under lip to make up for the uselessness of the teeth. The projecting nasal regions would prevent short lips from touching the ground.

The posterior position of the molar teeth indicates use for a long, slender tongue.

This species was probably quite as large as the Indian elephant, for the individual described is not adult, as indicated by the freedom of the epiphyses of the lumbar vertebræ; and fragments of others in my possession indicate considerably larger size.

The very weak dentition indicates soft food, no doubt of a vegetable character, of what particular kind it is not easy to divine. The long canines were no doubt for defence chiefly, and may have been useful in pulling and cutting vines and branches

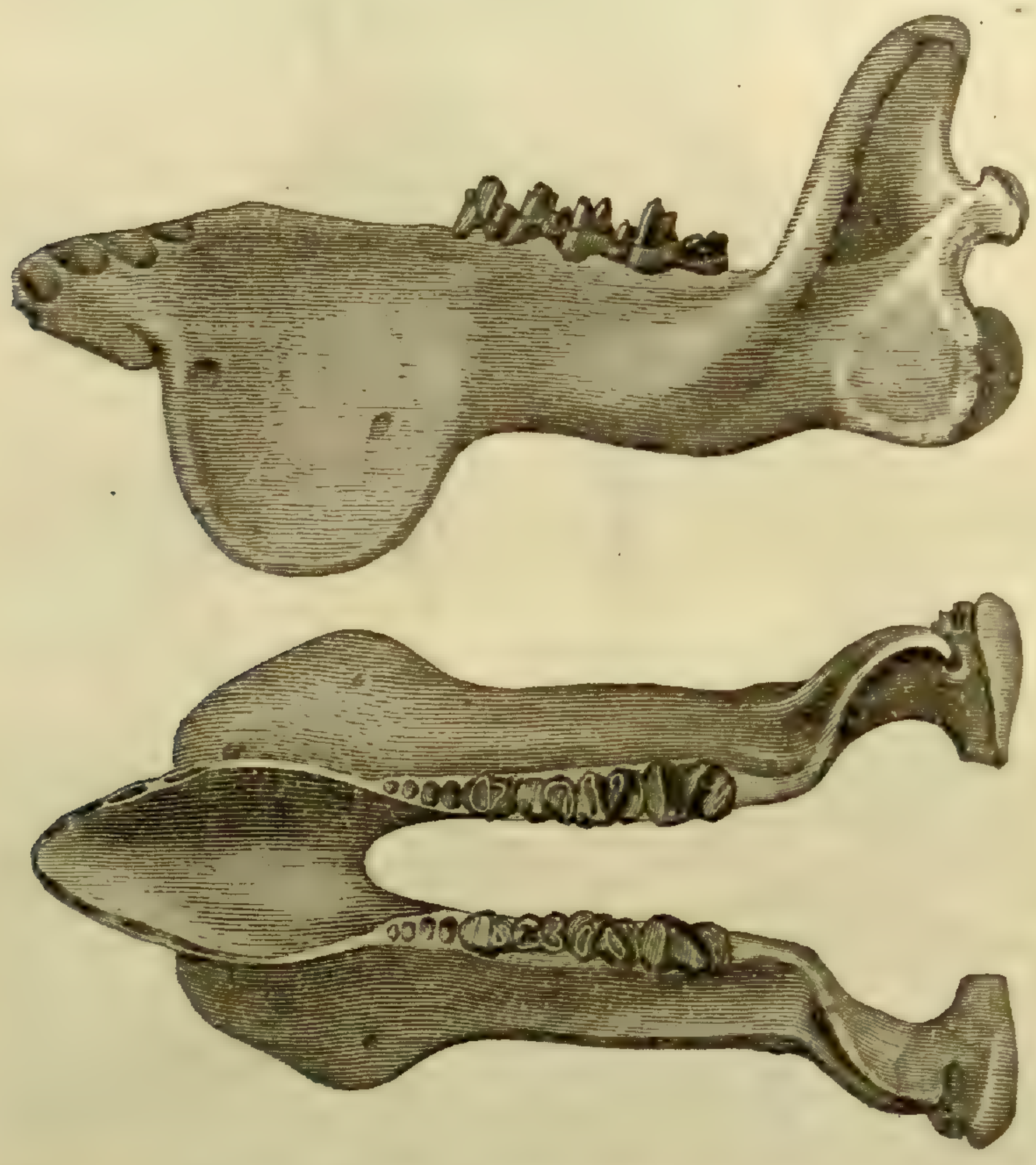


FIG. 34.—*Octotomus laticeps* Marsh, lower jaw, one-eighth nat. size; upper figure left side, lower figure from above. From Marsh, *Amer. Jour. Sci. Arts*, XI, Pl. V.

of the forest. The horns furnished formidable weapons of defence. The anterior nasal pair might have been used for rooting in the earth, if the elevation of the head did not render this impossible.

This huge animal must have been of defective vision, for the orbits have no distinctive outline, and the eyes were so overhung by the horns and cranial walls as to have been able to see but little upward. The muzzle and cranial crests have obstructed the

view both forward and backward, so that this beast probably resembled the rhinoceros in the ease with which it might have been avoided when in pursuit.

The genus Uintatherium Leidy, has the symphysis of the mandible more contracted than in the other genera, and the number of its teeth correspondingly reduced.[1] The type is the *U. robustum* Leidy, a species which is known from the posterior part of a skull with a few molar teeth of both jaws, and a superior canine tooth of one individual; and by the greater part of the lower jaw of another. It is of smaller size than those referred to Loxolophodon, and also smaller than the *U. leidianum* Osb. (Fig. 27). Besides these two species four others have been described by Marsh and referred to a genus Dinoceras, which is not yet known to be distinct from Uintatherium. The best known of these is the *U. mirabile* (Figs. 25, 26, 33), which has been well figured by Marsh. It lacks a tubercle of the last superior molar which is present in the *U. robustum*. Its lower jaw is unfortunately unknown. A species described by Marsh as *Dinoceras laticeps* is of larger size than the *D. robustum*, and Marsh figures its lower jaw (Fig. 34). It possesses four teeth on each side of the symphysis, as in Loxolophodon, but their form is not known. There is a deep flange of the lower edge of the ramus below the canine teeth, as in Uintatherium. As this form represents a genus clearly distinct from either of these, or Bathyopsis, I propose that it be called Octotomus. To this genus may belong some of the species now provisionally referred to Uintatherium.

In these animals the nasal tuberosities are small, and do not overhang the apex of the nasal bones. The median horns are anterior to the orbits, and are of various degrees of development in the different species. The posterior horns vary in like manner (compare Figs. 27 and 33). The supraoccipital crest extends much further posteriorly in the *U. mirabile* than in some of the other species.

In the genus Bathyopsis Cope, not only the incisors and canines, but also the molars are of the full number, *i. e.*, I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$. This, with the posteriorly extended expansion of the ramus of the lower jaw, distinguishes it from the other genera. But one species is known, the *B. fissidens* Cope, which

[1] See Cope, Proceeds. Academy Philadelphia, 1883, p. 295.

was an animal probably as large as the Javan rhinoceros (*Rhinocerus sondaïcus*), or rather smaller than the *Uintatherium robustum*.

The characters of the inferior molars in this and other genera of Dinocerata are very peculiar. In Bathyopsis they are constructed on the plan of those of insectivorous marsupial and placental mammals, so as to lead to the suspicion that its food consisted of Crustacea, or insects of large size, or possibly of thin-shelled Mollusca.

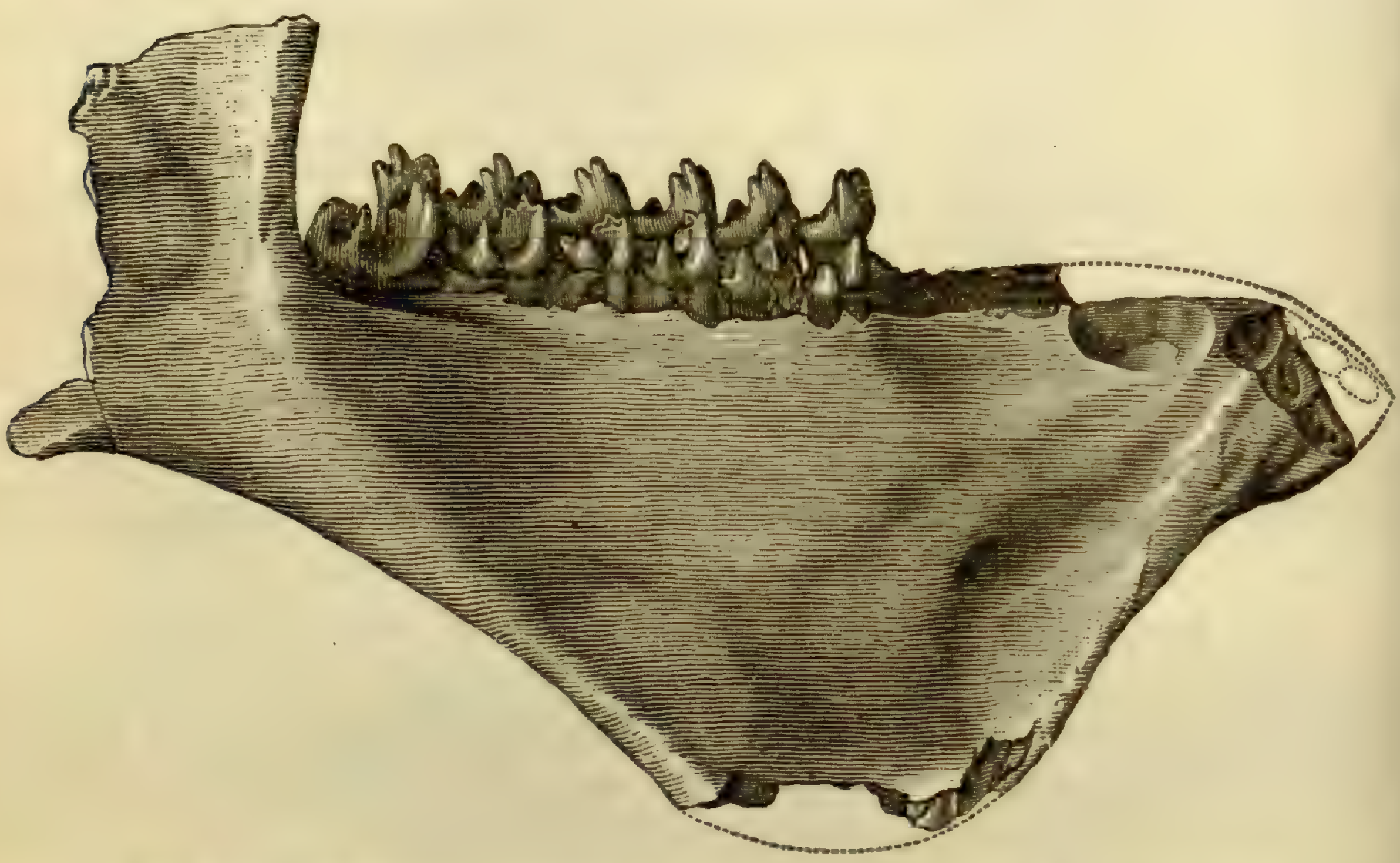


FIG. 35.—*Bathyopsis fissidens* Cope, mandible from right side, four-ninths nat. size. Specimen represented in Fig. 7. From the Wind River (Bridger) bed of Wyoming. Original, from Vol. III, U. S. Geol. Survey Terrs., F. V. Hayden.

The form of the ridges of the anterior part of the jaw of the *Bathyopsis fissidens*, together with the remarkably large dental canal and mental foramen strongly suggest that the animal possessed a large and perhaps prehensile lower lip. The lateral descending crests of the lower jaw must have affected the physiognomy curiously, especially when viewed from the front.

In the history of the discovery of the various types of the Amblypoda, we have an illustration of the prevision which the palæontologist may exercise as a legitimate inference from known facts. In closing his memoir on these animals (p. 44) Mr. Osborn remarks: "In the Upper Cretaceous or early Eocene lived a

group of animals which were the common ancestors of the Dinocerata and Pantodonta." This was written and published in 1881. In the following year, 1882, I discovered the Pantolambdidæ in the lowest Eocene bed known in America. How well this family fulfills the anticipations of Mr. Osborn may be seen by reference to the earlier pages of this essay on the Amblypoda (see NATURALIST, Vol. XVIII, p. 1111).

The tracing of the phylogeny of the Amblypoda from its earliest to its latest representatives, has presented us with an interesting chapter in brain evolution. It has been asserted[1] by Lartet, and repeated by Marsh, that there has been a continuous progress in the increase in the size and complexity of the brain in the Vertebrata, with the passage of geological time. This principle, as a whole, is confirmed by the results of my own studies. The Amblypoda constitute the sole exception known to me. The brain of the *Pantolambda bathmodon*, though of the same type as other Amblypoda, is relatively much larger than in its descendants of the Dinocerata and Pantodonta. It is a clear case of retrogression, and not of progression, in brain development.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The Presbyterian denomination, from the nature of its theology, is more disposed to critical and exact study than some of the other bodies of Christians. The relations of the doctrine of the evolution of species, and of the mental phenomena they display, to the prevalent theologies, are obvious. Not that it is necessary that teachers of righteousness should know all about the creation, but theology must have something to say on the subject. The discussion of these questions by Presbyterian ministers naturally produces a wider-spread agitation than in the case of Congregationalists, on account of the difference between the two churches in their system of organization, which does not give that independence to the congregation in the former that is possible in the latter. Thus while Mr. Beecher's advocacy of the evolution of man and its logical consequences, has not affected his standing in his church, when Dr. Woodrow, of the theologi-

[1] *Comptes Rendus*, June, 1868.

cal school at Charleston, S. Ca., sets forth the doctrine, the case is quite different. No less than three ecclesiastical bodies have investigated Dr. Woodrow, and he has been dismissed from his chair. Later Dr. Kellogg, of Pittsburgh, who has taught that the origin of man's body by evolution may be true, has been the object of disciplinary proceedings by the board of directors.

Since these supervisory bodies will not accept the results of the labors of the botanists and zoölogists on this subject, it would be well for them to endeavor to ascertain the facts for themselves. If they will select almost any of the genera of animals and plants which include a large number of species and individuals, and study their physical characters, they will find evidence of "origin by descent with modification," sufficient to satisfy any reasonable mind. They will reach the conclusion announced by a minister of the English Church from the north of England, at the meeting of the Evangelical Alliance held in New York a few years ago. In reply to the vigorous objections of Dr. Hodge, the author of the standard work of Presbyterian theology, he simply stated that he did not believe that the species of roses and some other well-known plants, were produced by independent acts of creation. This presentation is much more to the point than the argument, if such it can be called, of Dr. H. C. McCook, of Philadelphia, who recently took sides against the doctrine before a body of Presbyterians, in language some of which, if correctly reported, cannot be regarded as very weighty.

The loss of men like Winchell and Jordan and Woodrow is a serious one for any church. In view of the evident desire of Christians to know and teach the truth, would not the policy which has retained Drs. LeConte and McCosh in the Church, be more conducive to its future prosperity?

—— The laudable desire to perpetuate the fame of our great men of science is not only witnessed by busts and statues, but in an humble but sometimes quite as effective way by naming minerals or plants and animals after them. There are, however, different ways of doing this. Dr. David Sharp has chosen to render conspicuous both the objects of his own admiration and his own sense of what is fitting, by publishing in the "Comptes rendus de la Société entomologique de Belgique" for 1882, the following generic names of water-beetles: *Huxleyhydrus*, *Tyndallhydrus*, *Darwinhydrus* and *Spencerhydrus!* The London Entomological Society, at a late meeting, discussed the matter and

took the sensible view that "such hideous and unmeaning forms only tend to bring scientific nomenclature into contempt." The venerable Professor Westwood further remarked that "it was puzzling to imagine how any educated man (*vel doctus, vel doctor*) could deliberately write, much less print, such names; and still more, how any scientific society could allow them to appear in their transactions."

No editor or publication committee should allow such grotesque absurdities to go into print; and even then such barbarisms should be expunged; not to throw out such names, whatever nomenclatural codes are in vogue, is, we submit, an unpardonable leniency.

—— The numbers of the AMERICAN NATURALIST for 1884 were issued at the following dates: January, Dec. 29, 1883; February, Jan. 21st; March, Feb. 17th; April, March 15th; May, April 19th; June, May 17th; July, June 17th; August, July 17th; September, August 15th; October, Sept. 15th; November, Oct. 20th; December, Nov. 19th.

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RECENT LITERATURE.

MERRIAM'S MAMMALS OF THE ADIRONDACK REGION[1]—This well-written, elegantly printed volume is essentially a fresh and original contribution to the zoölogy of the Mammalia. Though restricted to the mammals of a limited area, the species have a wide geographical range, and the results of so much close observation, through a period of so many years, by a close and critical student, will be of permanent value. Sportsmen and naturalists will be under obligations to Dr. Merriam for this volume. It is purely biographical, with no descriptive or anatomical details. Moreover the matter is well presented, and will be found attractive, as we have reason to know, to boys interested in wood and field sports and nature.

The book is in the line of Audubon's Quadrupeds and Godman's American Natural History; with these works as a basis, the future student of mammals will, from work of this kind, be led more to the comparative study of coloration, of protective mimicry, of sexual selection and of instinctive and reasoning acts.

[1] *The Mammals of the Adirondack region, Northeastern New York.* With an introductory chapter treating of the location and boundaries of the region, its geological history, topography, climate, general features, botany and faunal position. By CLINTON HART MERRIAM, M.D. Published by the author, Sept., 1884. Reprinted from Vols. I and II, Transactions Linnæan Society, New York. Roy. 8vo, pp. 316.

If anything is wanting in the pages of the book before us, it is facts bearing on the psychology of these animals, such as are to be found in Morgan's work on the beaver. Studies of this kind have, however, to be mostly carried on with animals kept in confinement.

Regarding the change of color in the winter and summer pelage, Dr. Merriam has a good deal to say, as we have shown in a previous notice of the early part of this work, which originally appeared in the Transactions of the Linnæan Society of New York. Under the head of the varying hare the subject is again taken up, and the author insists that the change of color is due to the presence or absence of snow, or in his own words: "Both in spring and fall the time of the change seems to be governed by the presence or absence of snow, and is not affected by the temperature." A careful, detailed and comparative study of this subject is much needed. So far as we have looked into the matter, we have been disposed to consider Dr. Merriam's views with favor, but have learned from hunters facts which seem to show that temperature is not wholly without influence in producing the change. But why should not all of our northern mammals which do not hibernate, but are abroad when the snow is on the ground change their pelage? Why are the varying hare, ermine, arctic fox, etc., the only animals which change? Why do not the fisher and mink change as well as the ermine?

Whether the lay reader will be pleased with the use of the trinomial nomenclature remains to be seen. Perhaps occasionally useful in a strictly scientific treatise, why should not *Sciuropterus volucella hudsonius*, read *Sciuropterus volucella* var. *hudsonius;* the uninitiated reader would then understand that a well recognized variety of the ordinary more southern flying squirrel was meant. It is to be hoped that our trinomialists will not "run the thing into the ground."

We find no occasion for criticism in this admirable book, and excerpt some paragraphs concerning topics which appear new and fresh, though for that matter the entire volume smacks of out-of-door life, is redolent of the spruce and pine woods, and carries us back to the clear skies and sylvan retreats and mountain lakes of the noble Adirondack forests.

Speaking of the mole Dr. Merriam writes:

"The modification of structure that adapts this animal to its peculiar mode of life affords a most remarkable example of animal specialization. The conical head, terminating in a flexible cartilaginous snout, and unencumbered with external ears or eyes to catch the dirt, constitutes an effective wedge in forcing its way through narrow apertures; the broad and powerful hands, whose fingers are united nearly to their very tips and armed with long and stout claws, supply the means by which the motive power is applied, and serve to force the earth away laterally to admit the

wedge-like head; while the apparent absence of neck, due to the enormous development of muscles in connection with the shoulder-girdle, the retention of the entire arm and forearm within the skin, the short and compact body, and the covering of soft, short and glossy fur tend to decrease to a minimum the frictional resistance against the solid medium through which it moves. In fact, it presents a most extraordinary model of a machine adapted for rapid and continued progress through the earth.

"The mole does not, and cannot, *dig* a hole in the same sense as other mammals that engage in this occupation, either in the construction of burrows or in the pursuit of prey. When a fox or a woodchuck digs into the ground the anterior extremities are brought forward, downward and backward, the plane of motion being almost vertical; while the mole, on the other hand, in making its excavations carries its hand forward, outward and backward, so that the plane of motion is nearly horizontal. The movement is almost precisely like that of a man in the act of swimming, and the simile is still closer from the fact that the mole brings the backs of his hands together in carrying them forward, always keeping the palmar surface outward and the thumbs below. Indeed, when taken from the earth and placed upon a hard floor, it does not tread upon the palmar aspect of its forefeet as other animals do, but runs along on the sides of its thumbs, with the broad hands turned up edgewise."

Regarding the migratory habits of the gray squirrel, which have become almost a matter of tradition, the author writes:

"The minor migratory movements of this species occur with more or less regularity from year to year, but on so small a scale as to escape general notice. They must not be confounded with the great migrations, not rare in former times, when these animals, actuated by some unknown influence, congregated in vast armies and moved over the land, crossing open prairies, climbing rugged mountains and swimming lakes and rivers that lay in their path. Though hundreds, and sometimes thousands, perished by the way, the multitude moved on, devouring the nuts that grew in the forests through which they passed, and devastating the grain fields of the farmer along the route. Though these remarkable expeditions have been known and commented upon for many years, yet our knowledge of them is limited almost to the recognition of the fact of their existence. Scarcity of food very probably gives rise to the disquieting impulse that prompts them to leave their homes, but the true motives that operate in drawing them together, and in determining the direction and distance of their journeys are as little understood to-day as they were before the discovery of the continent on which they dwell.

"In the year 1749 they invaded Pennsylvania in such vast hosts as to endanger the crops of the entire inhabited portion of

the State, and a reward of three pence a head was offered for their destruction. This necessitated the payment of eight thousand pounds sterling (640,000 individuals having been killed) which so depleted the treasury that the premium was decreased one-half."

The book is readable throughout, and its carefully prepared biographical sketches will have a permanent interest.

GRAY'S SYNOPTICAL FLORA.[1]—Everything from the pen of Dr. Gray is welcomed by the botanists of the country as a contribution from one who is a master. A few years ago a volume appeared bearing the title Synoptical Flora, which covered the ground of the Gamopetalæ after Compositæ. The volume before us, which closely resembles its predecessor, includes the gamopetalous orders Caprifoliaceæ, Rubiaceæ, Valerianaceæ, Dipsaceæ and Compositæ. The two volumes thus cover the whole of the North American Gamopetalæ, and bring our knowledge of this great group down to the present.

It may be interesting to give here in concise form some of the results brought out by this volume. By taking Bentham and Hooker's Genera Plantarum and comparing our North American composite flora with the composite flora of the world, we find that we have representatives of eleven of the thirteen tribes into which the order is now divided. We have 235 genera out of 766, or about thirty per cent of the whole. Our species (nearly 1500) constitute about four per cent of the whole.

If we look over the tribes we find the per cent of North American genera and species to be as follows:

	Per cent of genera.	*Per cent of species.*
1. Vernoniaceæ	7½	2½
2. Eupatoriaceæ	43	14
3. Asteroideæ	36	29
4. Inuloideæ	10	4
5. Helianthoideæ	46	30¾
6. Helenioideæ	70	68
7. Anthemideæ	20	7½
8. Senecionidæ	36	8⅓
9. Calendulaceæ	0	0
10. Arctotideæ	0	0
11. Cynaroideæ	19	4½
12. Mutisiaceæ	10	2¼
13. Cichoriaceæ	52	6⅓

From the foregoing table it is readily seen that our flora is rich in genera, and that it is particularly so in Helenioideæ, Cichoriaceæ, Helianthoideæ and Eupatoriaceæ. In like manner we observe that the Helenioideæ, Helianthoideæ and Asteroideæ

[1] *Synoptical Flora of North America.* By ASA GRAY, LL.D., F.M.R.S. and L.S. Lond., R.I.A. Dubl., etc., etc. Vol. I, Part II. Caprifoliaceæ–Compositæ. Published by the Smithsonian Institution, Washington. New York, London and Leipsic. July, 1884, pp. 474.

are rich in species, the first named having about five times the normal per cent. On the other hand it is interesting to notice the low per cent of species of Vernoniaceæ, Inuloideæ and tribes seven to thirteen inclusive. Curiously the North American Cichoriaceæ, which contain fifty-two per cent of the genera, include but a little above six per cent of the species!

We can take no more space here for further notice of this most valuable addition to our botanical literature. We but express the earnest hope and wish of all workers in botany that the veteran author may be spared to give us the remainder of our flowering plants in the Synoptical Flora.—*C. E. B.*

ALLEN'S HUMAN ANATOMY.[1]—This work, the issue of the first part of which was noticed in this magazine, is now completed by the appearance of Section VI, which treats of the organs of sense, organs of digestion and genito-urinary organs. This part alone contains a hundred and sixteen wood-cuts and sixteen full-page engravings. It need scarcely be said that full justice is done to the various organs mentioned in the title page, but it may be added that a chapter is devoted to the superficial and topographical anatomy of the various parts of the body, and another most interesting one to embryology and the study of malformations—a subject to which Dr. Allen has given considerable study. The illustrations are so drawn as to be especially clear to the student.

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[1] *A System of Human Anatomy, including its Medical and Surgical Relations.* By HARRISON ALLEN, M.D. Philadelphia, Henry C. Lea's Son & Co. 1883.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICAN NOTES.—Capt. C. E. Gissing, R. N., has recently undertaken a journey inland from Mombasa, among the Wa-duruma and the Wa-teita, both of whom live in great dread of the Masai, who steal all the cattle they find, and kill their owners. The Wa-teita are rather undersized and are said to be very lazy, yet they live on mountain sides and summits, and cultivate the ground at the foot. The women do all the work, and carry firewood, utensils, etc., to the mountain top. Ndara, 4800 feet high, has a Wa-teita village at the top. This tribe are great robbers, but as they are armed only with bows and poisoned arrows, instead of spear, shield, and sword, they are always defeated by the Masai. Kasigao (5185 feet), has a village at 1500 feet elevation. In time of drought the natives of this part of the country sell their children as slaves to the coast people, but always redeem them in a favorable season. Although barbarous in their dealings with each other, they seem to have a horror of the regular slave trade as carried on by slave-dealing caravans.——Mr. O. Neill has discovered a lake (Lake Chiuta) to the north of Lake Shirwa, south of Nyassa. The climate of the highlands of this district (east of the Shiré) is said by Capt. Foot to be well suited to European constitutions, and adapted to wheat, oats, European vegetables, and coffee.——Lake Nyassa is becoming a busy inland sea. Two steamers ply upon it, and one upon the river Shire. There have been difficulties with the Makololo, owing to the death of their Chief Chipatula at the hands of an English elephant-hunter, but these seem likely to be settled by the efforts of Capt. Foot. On Lake Tanganyika there are now three steamers. The African Lakes Company has ten depots between Quillimane and Malawanda, on Nyassa, and from this point a practicable road has been carried to Pambete, on Tanganyika.——E. A. Floyer states that he rode from Wady Halfa to Debba, on the Nile, in

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

20¾ hours, and believes that the distance is not above 85 miles, and therefore is much exaggerated on the maps. A map of the Lower Congo, issued by the International Association in July, 1883, shows the river as flowing 100 miles more to the west than it is marked in the best recent atlases.——Gen. J. H. Lefroi, in his presidential address to the geographical section of the British Association, stated that Dr. Pogge's account of the kingdom of the Muato Yanvo (not yet translated) proved that the people were much in advance of their cannibal neighbors of Kauanda. They practice circumcision, and are a fine warlike race, but addicted to slave-hunting. Since Dr. Pogge's visit Muata Yanvo has been deposed and poisoned by the "Lukokesha," or second in authority in the kingdom, who is one of his half-sisters. The Muata Yanvo is chosen principally by the Lukokesha, but must be a son of the former king.——The Proceedings of the Royal Geographical Society for October give a list of 120 stations occupied by Europeans in Central Africa in 1884, with their latitude and longitude. Sixty-one of these are situated between the Equator and the Zambezi, east of 25° E. long., and fifty-nine west of longitude 25° E., between the equator and the Kuimén or Cunené. Twenty-six of the latter belong to the Belgian International Association, which has also four stations east of long. 25° E.——Through the letter of recommendation given by Sir John Kirk (British Agent at Zanzibar), who is in high favor with King Mandala, the ruler of Chagga, Mr. H. H. Johnston and his party are fed and clothed entirely at the cost of that potentate, who has given him a spot up the mountain (Kilimandjaro) where he can build a house and carry on his natural history work.——The Rev. W. P. Johnson has communicated to the Royal Geographical Society the result of seven years travels among the various tribes who inhabit the district east of Lake Nyassa, watered by the Lujenda and Rovuma and their tributaries. These streams rise east of the mountains which border the lake, and uniting in about 38° 10′ E. Long., flow to the Indian ocean. The district watered by them appears to be thickly peopled by settled and intelligent tribes, but the Gwangwara, a Zulu tribe that were driven northward about 30 years ago, oppress and enslave them, and the slave trade flourishes. The mountains do not exceed 4000 feet in height.

American Notes.—Dr. C. v. den Steinen, a member of the German expedition to South Georgia, has recently descended the before unexplored Xingu to its junction with the Amazons.——Another German traveler, Dr. G. Steinmann, who remained in South America at the conclusion of the work of the expedition to observe the transit of Venus, has, says Petermann's Mittheilungen, crossed the Atacama desert and ascended the Licancaur volcano to a height of 5400 meters, 400 meters below its summit. Here he found traces of ancient settlements, and of a path

to the summit.——The Danish gunboat *Tylla* has returned to Orkney from a successful expedition of four months' duration, during which a scientific exploration of the inland glaciers of Greenland was effected, and meteorological observations taken along the coast as far north as 70° N. lat. Much dredging and trawling was done, the former to a depth of 900 fathoms, and many unknown species were obtained.——A new island, in the form of a rounded flattened cone of considerable size, was seen on July 26 by the lighthouse-keeper at Cape Reykjanes, the south-west point of Iceland. Several earthquake shocks had been felt during the preceding days. A large part of one side of the cone has since slipped or fallen down into the sea.——Mr. Whitely contributes to the Proceedings of the Royal Geographical Society an account of his journey to the foot of the flat-topped mountains, Roraima and Kukenam, in British Guiana. He reckons the direct vertical sides of the latter (above the sloping part) at 1000 feet, and declares that its ascent seems impossible except by balloon. The vertical part of the Roraima seems rather less, and there is a break by which ascent may be possible. ——A report of considerable interest has been received from the Danish Expedition to East Greenland, dated Namortalik, March, 1884. Namortalik has thirty turf-covered houses, including a brewery and a bakery, also a Lutheran mission, a church, and a school. It is on an island, surrounded by several others, which are visited by the natives for seals and eider-duck. The whole southern part of Greenland is a region of wild mountains, rising in peaks to nearly 8000 feet. Close to Namortalik is the Tasermiut fjord, some 50 miles long, with a most luxuriant vegetation in summer, and with heat and mosquitos enough to make one fancy himself in the tropics.——The observations of Axel Hamberg, hydrographer of the recent expedition of Baron Nordenskjold to Greenland, are of the highest interest. Through Denmark sound, between Iceland and Greenland, flows a warm current, washing the western and northern shores of Iceland, and a cold polar current. The latter, throughout its whole course between 66° N. lat. and Cape Farewell, flows upon warm water. Its depth seems to increase with the depth of the sea, and its surface water is less salt than that of the warm current, which is thus specifically the heavier. The quantity of ice on the east coast diminishes in spring and summer, and, according to numerous observations made by Danish settlers and navigators on the south coast of Greenland, the polar drift-ice appears there in May, June and July, whereas in November, December, January and February there is no ice. Mr. Hamberg believes, therefore, that the polar current is at its maximum in spring, diminishes in force during summer, and is insignificant in autumn and winter. He hints that Nordenskjold owed his comparative success in reaching the east coast to the fact that he chose September instead of an earlier

month, and suggests that an attempt made in October or November would be still more successful.

Asiatic Notes.—*The Upper Oxus.* Mr. R. Michell (Proc. Roy. Geog. Soc., Sept., 1884) gives an account of Karateghin and Darwaz, regions situated on the upper course of the Oxus. Karateghin occupies the middle course of the Kizyl-see or Surkhab, the largest tributary of the Oxus; while Darwaz, to the south of Karateghin, lies upon the Panj or main Upper Oxus and upon the Hing-ab, a tributary of the Surkhab. These two Bokharian provinces are walled in by snow-capped mountains ten to eighteen thousand feet high, and can only be entered by ways passing over the most difficult passes. Karateghin consists of a series of hollows or expansions in the valley of the Surkhab, and each of these expansions gives evidence, from its terraced clayey sides, that it was once a lake. The smaller basins are separated by mountain spurs. Grain and fruits of the temperate climes grow in abundance in this elevated valley. The Tadjiks of Karateghin claim to be descended from the soldiers of Alexander's army, and Mr. Michell believes that the hereditary chiefs may really be so descended, but suggests that the Tadjiks themselves may be the descendants of the ancient Bactrians. The principal valley of Darwaz is the grassy and fruitful vale of the Hing-ab, whither, spite of the asperity of the roads, immense herds of cattle are driven every year from Hissar to graze.——Another well-to-do valley is that of the Saghri-Dasht, a tributary of the Hing-ab. The valley of the Panj itself has little cultivable land, but in it stands Kila-Khumb, the residence of the Bek of Darwaz. At the south-east limit of Darwaz is an impassable gorge, separating it from Roshan, which belongs to Afghanistan. Sir Hy. Rawlinson stated that Roshan was the exact Oriental rendering of Roxana, and it was here that the Bactrian chief, Oxyartes, the father of Roxana, had his residence. The Tadjik has straight, fine black hair, and deep-set, lively black eyes, and is thus quite different from the Uzbeg Tartars.

Miscellaneous Notes.—Mr. C. Winnecke has explored a part of central North Australia near the western boundary of Queensland, as far as 136° 46″ E. long. He has discovered various minor lakes and mountains and one river, the Hay, a feeder of the Marshall, but the general aspect of the country is that of a waterless desert of spinifex and low scrub, except in the valleys of the rivers, where there is grass and also gum and box trees. Eighty-five species of plants were collected, several of them new to science.——A recent work by an Austrian Slav enumerates the "Yongo slaves" or southern Slavs at 12 millions, without counting the four millions of Bulgarians. The Slavonian provinces of Austria, including Bosnia and Herzegovina contain eleven millions of Slavs. Counting Russians, Poles and Czechs, the Slavonians of Europe reach 100 millions.

GEOLOGY AND PALÆONTOLOGY.

RODENTIA OF THE EUROPEAN TERTIARIES.[1]—In this important monograph of 161 pages M. Schlosser has given us a much needed account of a series of Mammalia which has been hitherto much neglected. Comparatively little information as to the character of many of the European genera has been accessible hitherto, and we therefore welcome this work as filling an important hiatus in our literature. The greater number of the extinct species of Europe belong to the Hystricomorpha and the Sciuromorpha; and in the former suborder the important family of the Theridomyidæ is especially characteristic of that continent. To it M. Schlosser refers the genera Theridomys Blv. Protechimys g. n., Archæomys L. and P., and Trechomys Lart., which M. Schlosser remodels. The total number of species belonging to this family recognized, is fifteen. An important new genus is added to the Hystricomorpha, Nesokerodon Schloss., with two species from the French Phosphorites. Considerable attention is given in the monograph to the rooting of the molar teeth. The book is well illustrated with eight 4to plates.

A few blemishes appear in the text, such as the printing of the synonyms separately and in the same type as the correct names of the species. Also there is a good deal of confusion in the names and authorities which are quoted from the American literature of the subject.

MARSH ON AMERICAN JURASSIC DINOSAURIA,[2] PART VIII.—In introducing the description of the principal characters of the skeleton of the carnivorous Dinosauria Professor Marsh remarks that, "Although much has been written about these reptiles since Buckland described Megalosaurus in 1824, but little has really been made out in regard to the structure of the skull, and many portions of the skeleton still remain to be determined." This being the fact, "the fortunate discovery of two nearly perfect skeletons of this order, as well as a number of others with various important parts of the skeleton in good preservation, has afforded the writer an opportunity to investigate the group." The best preserved remains belong to species of Allosaurus and Ceratosaurus. The latter genus proves to be one of the most curious of the Dinosauria. Marsh finds that the bones of the pelvis are coössified as in birds; and in a subsequent article (*l. c.*) that the metatarsals are coössified also, giving a metapodium a good deal like that of a penguin. These facts quite close the argument in favor of the descent of the birds from the Dinosauria, although

[1] Die Nager des Europäischen Tertiärs nebst Betrachtungen ü. d. Organisation u. gesch. Entwickelung der Nager überhaupt; von M. Schlosser: Palæontographica, July, 1884.

[2] The principal characters of American Jurassic Dinosaurs, Part VIII, order Theropoda. On the United Metatarsal bones of Ceratosaurus. *Amer. Jour. Sci. Arts*, 1884, Pt. I, 329; Pt. II, p. 161.

in some of the pelvic characters we must, according to Baur, look to the herbivorous forms for the closest resemblance. The cervical vertebræ of Ceratosaurus have a very peculiar articulation, being deeply concave posteriorly and plane in front, thus preventing the reception of the anterior face deeply into the posterior face of the centrum in front. The depth of its shallow entrance is marked by a ledge on the sides of the anterior face. The skull of Ceratosaurus is peculiar, according to Marsh, in the large anteorbital opening.

Professor Marsh separates Ceratosaurus as type of a family distinct from the Megalosauridæ, but it does not appear from his diagnosis of the latter on what grounds. The only distinctive character given to the former is "horn on skull," which is certainly of not more than generic value, and may not even be that. The skeleton of the Megalosauridæ is little known, but it is probable that the Ceratosauridæ must be distinguished from them by the coössified metatarsals and pelvic bones. The other distinct family appears from Marsh's definitions to be the Zanclodontidæ, where the cervical vertebræ are biconcave, and the pubes different. I have elsewhere[1] referred to Professor Marsh's tendency to exaggerate the systematic value of various characters,[2] and reiterate the opinion that his "orders" are of no higher rank than suborders.

As usual, Professor Marsh omits the customary reference to facts already determined by others. Thus he states that some of these reptiles probably rested on the free extremities of the pelvis in a sitting posture (p. 336). The writer pointed out this peculiarity as long ago as 1870.[3] Professor Marsh also finds (p. 337) that the presence of various genera of Dinosaurs, closely allied to these American forms, in essentially one horizon in the Isle of Wight, suggests that the beds in which they occur are not Wealden as generally supposed, but Jurassic. The American beds were at first referred to the Wealden by Marsh, and subsequently to the Jurassic by the writer in "Relations of the Horizons of Extinct Vertebrata of Europe and North America."[4]

This paper is well illustrated by six plates.—*E. D. Cope.*

[1] Proceedings Academy Philada., 1883, p. 97, on the structure of the skull in the Hadrosauridæ.

[2] Another illustration of this is seen in a short article by Professor Marsh immediately succeeding the first one now reviewed, "On a New Order of Extinct Jurassic Reptiles, Macelleognatha." This supposed order reposes on a symphysial portion of a ramus which looks like the corresponding part in various reptiles, and which is edentulous at its extremity. The absence of teeth or of a few teeth, does not constitute an ordinal character; so that this name must be ranged with those of Sauranodontia and Pteranodontia of the same author, as unnecessary additions to nomenclature.

[3] Extinct Batrachia Reptilia and Aves N. America, p. 122 E.

[4] Report of the Proceedings Congress Geologists, Paris; Bulletin U. S. Geol. Surv. Terrs. Vol. v.

THE EOCENE OF NORTH CAROLINA.—I have recently ascertained by the discovery of the unmistakable superposition of the small outlines of Eocene fossiliferous rocks (noted in the text and geological map of the State, in the report of 1875), and of other similarly situated patches of the same beds, with upper Eocene shells, capping the highest hills of the so-called drift or quaternary, that nearly all of these beds of sand and gravels heretofore referred to the latter horizon are of Eocene age. The area of Tertiaries in this State must now be extended over a wide stretch of country, from the tops of Laurentian hills, near Raleigh, and the higher elevations of the Huronian slates, to from fifty to seventy-five miles south-eastward, along the course of the Deep river, and so onward to the South Carolina border, reaching at one point an elevation of 600 feet above tide. This leaves the quaternary, like the Miocene, to be represented by a thin and broken covering of superficial deposits, of only a few feet to a few yards in thickness, and reaching from the coast only about 100 miles inland and an elevation but little above 100 feet.—*W. C. Kerr, Raleigh, N. C.*

CHARACTER OF THE DEEP-SEA DEPOSITS OFF THE EASTERN COAST OF THE UNITED STATES.—At the Newport meeting of the National Academy of Sciences, Professor A. E. Verrill gave the results of explorations made last summer by the U. S. Fish Commission steamer *Albatross*, sixty-nine dredgings having been made during four trips between Wood's Holl and a point off the Virginian coast. Of these dredgings, 5 were in depths between 2000 and 2600 fathoms (4 successful); 20 were between 1000 and 2000 fathoms; 24 between 500 and 1000 fathoms; 8 between 300 and 500 fathoms; 12 between 75 and 300 fathoms. Another trip has since been made to explore more extensively the zone between 40 and 100 fathoms.

Some very interesting and important discoveries were made in regard to the nature of the materials composing the sea-bottom under the Gulf stream at great depths. These observations are of great interest from a geological point of view, and some of them are contrary to the experience of other expeditions, and not in accordance with the generally accepted theories of the nature of the deposits far from land. The bottom between 600 and 2000 fathoms, in other regions, has generally been found to consist mainly of "globigerina ooze," or, as in some parts of the West Indian seas, of a mixture of globigerina and pteropod ooze. Off our northern coasts, however, although there is a more or less impure globigerina ooze at such depths, at most localities beneath the gulf stream this is by no means always the case. The ooze is always mixed with some mud and sand, and frequently with much clay-mud. In a number of instances the bottom at depths below 1000 fathoms has been found to consist of tough and compact clay, so thoroughly hardened that many

large angular masses, sometimes weighing more than fifty pounds, have been brought up in the trawl, and have not been washed away appreciably, notwithstanding the rapidity with which they have been drawn up through about two miles of water. In fact these masses of hard clay resemble large angular blocks of stone, but when cut with a knife they have a consistency somewhat like hard castile soap, and in sections are mottled with lighter and darker tints of dull green, olive, and bluish gray. When dried they develop cracks, and break up into angular fragments. This material is genuine clay, mixed with more or less sand, showing under the microscope grains of quartz and feldspar, with some scales of mica. More or less of the shells of globigerina and other foraminifera are contained in the clay, but they make up a very small percentage of the material.

In all our ten localities, between 2000 and 3000 fathoms, the bottom has been "globigerina ooze." We have never met with the "red clay" which ought to occur at such depths, according to the observations made on the cruise of the *Challenger*.

The temperatures observed with the improved thermometers now used on the *Albatross* were between 36.4° and 37.0° F., in 2000 to 2600 fathoms. But temperatures essentially the same as these were also taken in 1000 to 1500 fathoms, and even in 965 fathoms one observation gave 36.8° F. It follows from these observations that nearly the minimum temperature is reached at about 1000 fathoms in this region.

Geological News.—*General.*—The water of the Atlantic, Indian ocean, Red sea, and eastern part of the Mediterranean, has been shown by M. Dieulafait to contain manganese. The manganese can scarcely be perceived in sediments consisting of suspended matter, but is very perceptible when the water is free from suspended particles. In this way the well-known concretions of manganese in the deep seas were accounted for. He concludes that one of the conditions for the formation of chalk is the absence of foreign substances, and thus it may be expected that chalk should generally be rich in manganese. It was found that the quantity of manganese in fifty-six specimens of chalk from the Paris basin was fifty times more than in specimens of granular colored limestone.

Archean.—M. Barrois calls attention, in his notes on metamorphic rocks of Morbihan, to the way in which the schists gradually lose their crystalline character as they recede from the granite, until at length they pass into slate; while the metamorphic sandstones also change as they approach the granite, so as to show four distinct stages.

Devonian.—M. Paul Vernskoff has published an important memoir upon the Devonian deposits of Russia, comprising: (1) their geographical distribution in the centre and north-west of that

country; (2) a historical account of investigations of these deposits; (3) a description of their structure, and (4) a comparison of the Devonian of Russia with that of western Europe. The author concludes that the lower stages of the Devonian are lacking in Russia, which has only the middle and upper stages.

Carboniferous.—M. Fuchs has brought together abundant details respecting the geology of Cochin China and Tonkin. The carboniferous limestone is particularly well-developed, is of crystalline structure, and generally gray or blackish in tint. These rocks are violently dislocated in Tonkin and at Tourane, and form crenellated inaccessible cliffs of most picturesque shape. The islets and reefs which border the northern coast of the Gulf of Tonkin, and which have for centuries been the refuge of pirates, are formed of this rock. Upon these limestones rest beds of clay-sandstones with layers of coal at their base. These beds spread over large areas, and are certainly more than a thousand meters in thickness. Some twenty species of plants, some new, others like European coal measures, have been described. M. Fuchs then describes the coal basin of Tonkin, which forms a belt about 111 kilometers long, parallel with the coast. Only the southern border of this has been explored. The best known coal regions of Tonkin are those of Hon-Gac and of Ke-Bac. Analysis has proved that the coals of Tonkin are combustibles of good quality, adapted to diverse industrial uses.——W. Dames in remarks upon the supposed "Phyllopod" nature of Spathiocaris, Aptychopsis and similar bodies, maintains that some of these are undoubtedly goniatites, and that others cannot at present be interpreted, but that among these last none are phyllopodous.

Permian.—M. A. Gaudry announces that the study of Euchirosaurus has been facilitated by that of portions of Archegosaurus which have recently been found. Euchirosaurus possessed an abdominal cuirass, and was capable of powerful lateral motion, so that it was truly a reptile, progressing in reptilian fashion. The scales of the cuirass were very hard, and the vertebræ had neural spines which not only had lateral processes like those of several American species, but was also furnished with articular facets so as to be slightly movable upon the centrum.

Jurassic.—M. De Loriol continues, in the *Palæontologie Française*, the publication of his monograph of the Jurassic crinoids of France. Sixty-four species of Millericrinus alone have been described from the Jurassic beds, and twenty-six of these are new. All but four of the known species of this genus have now been found in France. No modern species recalls in the least this form of crinoid, with its pyriform or even globular calyx mounted on a long stem fixed by numerous tendrils.——M. Cotteau, in a memoir of the echini found in the limestones of the celebrated locality of Stramberg, in the Carpathians, enumerates twenty-

eight species, of which five are new, while the others have all been found in the Corallian or Kimmeridgian of other localities. The beds are thus proved to be Upper Jurassic.——In the specimen of Archæopteryx in the Berlin Museum, those parts are preserved which are wanting in the example in the British Museum, and the pelvis, hind limbs, and more perfect tail supply valuable details. These are worked up in the memoir "Ueber Archæopteryx" in the Palaeontologische Abhandlungen, Berlin, 1884, by W. Dames.

Cretaceous.—The variability of ancient species is well demonstrated by five abnormal specimens of Hemiaster from the cretaceous of Constantine, Algeria. In some of these one of the ambulacral areas is entirely or partially atrophied, while in others there is a doubling of one of the ambulacra. These animals, provided with four or six ambulacra, attained as full a growth as normal examples.

Tertiary.—The series of tertiary deposits which lie along the Alsatian slope of the Vosges, and which are often rich in bitumen, have by M. Blecher been determined to belong to the Tongrian stage. The deposits are sometimes marly and of deep-sea origin, at others sandy and littoral, according to the widening or narrowing of the zone between the Vosges and the Black forest. The vegetable fossils are numerous and remarkable.——M. Pomel considers the terrestrial deposits of the Sahara as forming two categories. The more ancient he places in the pliocene, and names Saharian. The author endeavors to show that, during the pliocene and quaternary, the maximum zone of precipitation was displaced northwards, and successively passed from the central Sahara to the Atlas, then to central, and lastly to northern Europe.

BOTANY.[1]

THE FERTILIZATION OF THE MULLEIN FOXGLOVE (SEYMERIA MACROPHYLLA).—The mullein foxglove is similar to the passion flower of Ohio in flowering for only one day. Both begin to flower early in the morning. Seymeria perishes with nightfall, the passion flower lasts till about midnight. The Seymeria is of a yellow color, has but a short tube and is wide at the mouth. Were it not for the numerous hairs in the throat of the tube, it would be of easy access to all classes of insects. The lower hairs seem to be in decided disorder, while those on the upper parts of the tube all point to the entrance. They serve as guards to the flower, of which the lower part of the throat is incurved so as to bring the tube together at that point. The middle lobe of the lower lip has a series of hairs on either side and between these rows of trichomes is a portion free from them (Fig. 1) so

[1] Edited by PROFESSOR C. E. BESSEY, Lincoln, Nebraska.

that the rows serve the bees as a guide, leading them by means of the smooth portion directly to the stamens and style beyond.

The lower stamens appear at either side of this groove at the corolla's throat (Fig. 1), the upper stamens are shorter and entirely included. The style is slightly shorter than the lower stamens and lies between them (Figs. 2 and 4) in such a way that if the bees fail to visit it, it can be self-fertilized, *i. e.*, if the pollen of its own flower is not impotent. The stamens are erect in the bud and the style is but slightly curved forwards. In the older

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

FIG. 1.—Flower from front view. FIG. 2.—Section of flower. FIG. 3.—The style. FIG. 4.—Stamens and style seen from below.

flowers the style is often more curved, so as to bring it into more decided contact with any entering body. The stigma (Fig. 3) is not exactly lobed, but the harder tissues at its tip are lobed, and a softer layer of tissue lies between, exuding a sticky substance. The flower is therefore but poorly specialized for cross-fertilization, the hairs constituting its only special characters. I have noticed most of the visits by bees in the evening. In the middle of the day they seem to prefer other plants.—*Aug. F. Foerste, Granville, Ohio.*

BOTANY IN KANSAS.—In the first number of the Bulletin of the Washburn Laboratory of Natural History Professor F. W. Cragin publishes lists of Kansas mosses, lichens, algæ and fungi. Of the mosses a dozen are given, determined by Eugene Rau. The lichens were identified by H. Willey, and number sixteen species and varieties. A dozen algæ are given, identified by Francis Wolle. The list of fungi includes only the Hymenomycetes, of which 158 species are enumerated. In this latter list are some new species, viz., *Agaricus alveolatus* Cragin, with a pitted pileus; *Trametes kansensis* Cragin, and *Dædalia tortuosa* Cragin. This bulletin gives promise of good work, and no doubt will do much to stimulate the collection and identification of the lower plants of the State.

FERTILITY OF HYBRIDS.—From a long article recently published by Thos. Meehan, we condense as follows, regretting that space will not permit its reproduction entire.—[*Ed.*]

The facts are that the recorded and undisputed cases of sterility in hybrids among plants are so rare that it would seem the onus should be on that side to prove the point. The writer does not know where to look for cases of undoubted hybrids among

plants that are sterile. In most cases where reference is made it has been assumed that they were hybrids, because there was some difference in appearance from the normal form, or perhaps from the simple fact of sterility alone. The curious *Pyrus polvilleriana* in the garden of the museum at Paris is a case in point. This was known in Bauhin's time, and when the knowledge of hybridism was developed, believed to be a cross between an apple and a pear. It bore fruit, but it was thought there was no seed in them. But in 1860 Decaisne cut large numbers open and found thirteen seeds in 150 fruits. In 1864 sixty-two seeds were found in 139. Now the very fact of the fertility varying with different seasons shows that sterility was in relation to the structure in connection with external circumstances, rather than to any physiological imperfection in the reproductive organs themselves. In some other locations, where the circumstances should be uniformly as they were in 1864, we should have a tolerably fertile tree. Seedlings from the tree showed a relationship to *Cratægus aria*, and, indeed, from what we know of departures from normal types without any pretensions to hybridism, one may say that there is no fair reason for regarding this curious tree as a hybrid, or the sterility as having anything to do with the question of hybridization.

The writer has a tree certainly raised from *Halesia tetraptera*, certainly no hybrid, as there is nothing near for the parent tree to hybridize with, which is so different from the parent type that it can scarcely be called a Halesia. It is as sterile as the most famous hybrid could be. In short, sterility is well known to often follow the union of two individuals in the animal kingdom, and there are innumerable cases of sterility among individual plants. Sterility will often be characteristic of a whole race, and often of a whole species; and we may say positively that there is no more sterility among recognized hybrids than we find of every-day occurrence where hybridization is certainly out of the question.

But let us give the illustrations of fertility in hybrids:

* * * Flowering plants furnish the best evidence because we know the whole history. The writer of this raised the first hybrid fuchsia. *Fuchsia fulgens* was the male parent and *F. longiflora* the female, the latter being itself a garden form. These two belonging to different sections of the genus, are not only good species, but have been regarded as of distinct genera. The progeny of these hybrids were fertile. Other hybridists used equally distinct species for the male parents, such as *F. corymbiflora* and *F. serratifolia*. All the numberless garden varieties now in existence have been raised from these original hybrids. Many successive generations have been raised. There are some sterile individuals occasionally, but not more than is found with individuals with normal species. The writer also obtained hybrids be-

tween Gesneraceous plants of two genera, *Gloxinia rubra* and *Sinningia guttata*. These were fertile. Indeed, European florists have united many supposed genera in this order. Conservatories teem with them. The writer never saw a sterile one. This is also true of Begonia. Large numbers of those in our conservatories are hybrids, all fertile. * * * * All our garden Gladioli are fertile. The original of these forms is a hybrid between *Gladiolus cardinalis* and *G. floribundus*. Our garden geraniums and pelargoniums are from many very distinct species, so distinct in appearance and general character that they might almost be regarded as distinct genera. Their offspring are occasionally sterile, but with these very few exceptions are as fertile through many score of generations as the originals. * * * * The Cape heaths of our greenhouses—species of Erica—have remarkably distinct forms among them, yet any of them hybridize freely and produce offspring as fertile as their parents. * * * * In the history of American fruits we find remarkably strong evidence for the fertility of hybrids. * * * The history of the grape in America is one of a long succession of fertile hybrids, though perhaps the distinctness of the species might be a question. There is such a regular gradation that no one can refer a form in every case to its proper species. Still, when we take the wild fox grape and compare it with the grape of European vineyards, or a scuppernong and a fox grape, all will admit that in no sense can these be regarded as one species. Yet they all hybridize, and the hybrids are fertile. * * *

M. Naudin, a very energetic French experimenter with hybrid plants, gives as the results of his observations that never more than twenty-five per cent of hybrids were sterile, and of these numbers had fertile pollen; but even this proportion may have had more to do with the climate or surroundings than with absolute sterility. In America, so far as the writer of this has had the opportunity to observe, there is no reason to believe there is any more sterility attached to hybrids than to ordinary plants.—*The Independent.*

The Younger School of Botanists.—In a recent number of *Nature* Rev. Geo. Henslow spoke of the "evil effects of the younger school of botanists not recognizing the importance of first training students in a thorough course of practical and systematic botany before proceeding to laboratory work." To this W. T. Thistleton Dyer replies with some warmth: "I am afraid I am not wholly free from some responsibility for the proceedings of 'the younger school of botanists,' the effects of which he regards as evil. In the face of the successful revival in this country of many branches of botanical study which the younger school has effected, I am emphatically of the opinion that these effects are the reverse of evil. I believe I was one of the first to organ-

ize a course of so-called laboratory work in botany on lines which it is only right to say were borrowed and extended from the teaching and example of Professor Huxley. In what I attempted I had the generous aid of many now distinguished members of the younger school. I do not doubt that they have immensely improved on the beginning that was in the first instance somewhat tentatively made. But the principle, I believe, has always remained the same, namely, to give the students a thorough and practical insight into the organization and structure of the leading types of the vegetable kingdom. When, therefore, Mr. Henslow, himself a teacher, asserts that such laboratory teaching as this should be preceded by a thorough course of practical and systematic botany, it appears to me that he is bound to explain what he precisely means by this very dark saying. For if botanical laboratory work in this country is not thorough, is not practical, and in dealing with types drawn from every important group is not systematic, it is important to know in what respects it falls short of these requirements."

NEW SPECIES OF NORTH AMERICAN FUNGI.—*Septoria purpurascens.*—Hypophyllous on small reddish-purple spots without any definite border, and often confluent so as to give a purplish discoloration to large areas of the leaf; perithecia prominent, scattered, collapsing above, 150-190μ in diam.; spores fusiform, hyaline, slightly curved, endochrome thrice divided, 30-50 × 3μ On leaves of *Potentilla norvegica*, Adirondack mountains, N. Y., Aug., 1883. Collected by Dr. Geo. A. Rex. This can hardly be *S. sparsa* Fckl., which has spores narrowly filiform and straight, nor *S. fragariæ* Lasch., which has spores shorter and broader at one end. *S. potentillæ* Fckl., is a Gloeosporium and quite different.

Pestalozzia scirpina.—Seated under the cuticle through which the black mass of spores is visible. Conidia fusiform, 4-septate, brownish-black except the hyaline extremities, 20-25 × 6-7μ; crest mostly 3-parted, cilia spreading, 18-24 × ½-¾μ; pedicels about 10μ long. The conidia at length ooze out and stain the surface of the matrix. On culms of *Scirpus maritimus.* Collected by Dr. J. T. Rothrock in Maryland, July, 1884. *Epicoccum sphærospermum* Berk., and *Macrosporium scirpi* Lasch? also occur on the same culms.

Cercospora racemosa.—In small (1–2^{mm}) patches, greenish-white at first then brown and often subconfluent; hyphæ interwoven, branched, hypophyllous brown, 200 × 4-6μ. Conidia oblong-cylindric, sub-hyaline, 1-5 septate, 20-80 × 3-6μ, borne in a racemose manner at the tips of short lateral branches. Differs from the usual type of Cercospora in its lateral conidia and scarcely tufted hyphæ. Collected at Charles City, Iowa, Sept., 1882. On leaves of *Teucrium canadense*, by Professor J. C. Arthur.

Ovularia monilioides.—On reddish-brown, round spots, 1-4^{mm} in diameter; hyphæ fasciculate, hyaline, sparingly septate and often branched above, 35-50 × 3μ; conidia concatenate, 2-4 connected, obovate, hyaline, 12-17 × 9-12μ. On leaves of Myrica. Collected at Magnolia, Mass., June, 1884, by Miss C. H. Clarke.

Sphærella platani E. & M.—On round (2–4^{mm}) reddish-brown spots with a narrow dark but only slightly raised border. Perithecia epiphyllous, innate-erumpent (90-120μ); asci oblong 8-spored, 40-60 × 12-15μ, nearly sessile, sporidia subhyaline, ovate-oblong, 1-septate and constricted, nucleate, 14-16 × 4-6μ. Quite distinct from *S. platanifolia* Cke. On living leaves of *Platanus occidentalis*. On the same leaves, on similar spots, is a Phyllosticta which can hardly be distinguished from the Sphærella except by microscopical examination. Perithecia epiphyllous, black, about 100μ in diameter; spores oblong-elliptic, brownish, faintly nucleate, 5-6 × 2.5-3μ.—*J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Botanical Notes.—The October number of *The Microscope* contains an article, by Mrs. L. R. Stowell, on the microscopic structure of *Hydrastis canadensis*, accompanied by two good plates.——Professor Trelease's paper in the Aug.-Sept. number of *Psyche*, Notes on the Relations of two Cecidomyans to Fungi, has a botanical as well as an entomological interest.——The last number (Oct.-Nov.) of the *Botanical Gazette* is devoted to the botanical aspect of the American Association for the Advancement of Science. Short abstracts are given of the more important papers read before the association and the Botanical Club. An account is given of the excursions of the club, and finally the whole is summed up in an editorial note upon the results of the Philadelphia meeting, in which, after pointing out the good results which the meeting accomplished, the editor properly criticises "the low average quality of the botanical papers presented before the association." In spite of the fact that the attendance included "some of the most distinguished names of the science in this country, the botanical communications in no instance exhibit that profound research or comprehensive statement of laws or relationships, or other characteristics that would entitle them to rank with the better papers presented by the zoölogists, physicists or chemists." We most heartily endorse the remark that "it lies with individual workers to see that this does not remain so."

ENTOMOLOGY.

C. Emery on the Fire-fly of Italy.—Luciola is one of the Lampyrid beetles, differing from Lampyris chiefly by the head being less deeply sunk in the prothorax. Both male and female have wings and elytra, the male has only six abdominal segments against seven in the female; but the terminal segment of the

male is large and bears indications of transverse division, as if it represented two somites.

Dr. C. Emery, of Bologna, was induced to examine this species (*Luciola italica* L.) by the publication of Wielowiejski's study of Lampyridæ in Zeitschrift f. Wissen. Zoologie, 1882. His own work was cut short by want of material, as last season was unfavorable in Italy; and it is only the preliminary views which he now publishes (same journal May, 1884). Some of these results are valuable.

He thinks that the female Luciola, though having wings, is unable to fly; though a friend alleged that he found both sexes flying *in copula*. The females are always very scarce, have two luminous spots on the ventral part of the abdomen (5th abdominal segment), whilst the males are common, and have the ventral parts of the 5th and 6th abdominal segments forming a large luminous organ. He is of opinion that in the imago state they never eat, and he finds the fore intestine filled with large air-sacs. [It might be well to compare this with the rectal air-sacs of larvæ of dragon-flies, and to see whether they may not be extensions of the tracheal system into the intestine, thus serving as lungs, and correlated with the great oxygen-consumption in the luminous organ].[1]

The abdomen contains the luminous organ in its ventral half, backed dorsally by a fat-body with concretions of uric acid. There are also fat masses in the prothorax, that of the male as well as its testes being rose-colored. The luminous organ is richly supplied with tracheæ, the larger tracheal trunks being *lined with bristles;* and the fine tracheal stems or branches run downwards through the luminous organ, perpendicularly towards the horizontal surface of the abdomen.

On a ventral view with weak magnifying the luminous organ is found to consist of bright round or oval areas, one of the perpendicular tracheal stems being in the center of each area, and between the bright areas are dark interspaces. The whole organ is constituted of vertical columns or cylinders, consisting of transparent tissue surrounding a tracheal stem and its branches, and the gaps between adjoining columns filled up by cellular "parenchymatous" matrix.

In a side view we can see the large tracheal trunk sending down the vertical stems, and marked not by spirals, but by transverse ridges. [This is one of the many incidental proofs coming up that the tracheal system has been misunderstood, that it is really the result of crenulations, and that there are no distinct spiral threads. Emery says: "I speak purposely of transverse ridges of chitin, and not, as is usually done, of a chitinous spiral, for such does not in fact exist here."]

By teasing the substance of the luminous plates we are able

[1] The remarks in brackets are by the reviewer.

to follow the tracheal branchings. Each stem forming the axis of a column, divides racemosely into branches, and each branch bifurcates into a pair of capillaries whose walls are perfectly smooth.

On the application of osmic acid to the abdomen of the living insect, death does not follow immediately, but the luminosity is continued for a time steadily. Long before the animal has ceased to move, the luminous plates begin to grow brown, the change proceeding from the anterior part, from the place where the tracheæ enter. The brown color becomes concentrated in round fields corresponding to the vertical columns, each surrounded by a circle of light.

The terminations of the vertical tracheal stems are enclosed in cylindrical lobular masses, the columns of the luminous organ, the tracheæ sending out its racemose branches within each column; in macerated specimens (by osmic acid and thymol) dark masses are seen where the branches bifurcate to form the capillaries; the cells of which the columns consist exhibit no nuclei. [Judging from these figures it would seem as if the dark spots represented the nuclei: if this be the case every tracheal branch is in a cell and its place of bifurcation at the cell-nucleus.]

Emery finds no case of the anastomosing of the tracheal capillaries either of the same or of different stems; he is satisfied that no such anastomosing occurs in Luciola. His view is opposed to that of Kölliker and of Wielowiejski on Lampyris. [The conclusion of Wielowiejski appears to be without sufficient foundation; his figures show only a casual collection of a few of the intricately twining tubules.]

The cylindrical lobes or columns of the luminous organ are separated from each other by a granulated substance, and the tracheal capillaries extend to this and to the granulated parenchyme-cells, penetrating between the cells but not entering them.

The dorsal fat-layer was examined for the purpose of establishing homologies. It is white, has urate concretions swimming in the plasma of its cells, which are not distinctly limited by cell walls; but it has nuclei like those of the parenchyme of the luminous organ; and these facts as well as the tracheal arrangements favor the view that the luminous parenchyme is derived from the fat-body. It cannot be that the latter with its urate concretions is the result of combustion in the luminous organ, for the tracheal arrangements negative such a view.

In comparing Lampyris, Emery concludes that M. Schultze's tracheal end-cells are represented in Luciola by the bright cell-elements of the luminous cylinders enclosing the tracheal stems; that the tracheal branching is similar; also that the reactions are the same, osmium being precipitated so as to darken the substance in both cases. In Luciola there is a higher differentiation of parts.

Transversely striped tracheæ never enter the fat-masses of Luciola; it is only the smooth tracheal capillaries that pierce them, somewhat coarser than those of the luminous organ, and retaining air in their lumen. The fine branches here arise not in a racemose manner, but by a fascicle of two or more capillaries arising at a point, and running in complicated windings before they enter the fat masses. They were never seen to anastomose; the layer of matrix was very thin on the striped tracheæ, but much thicker on the capillaries. Sometimes the ends of the capillaries lying on a cell of the matrix were free; between two capillaries the matrix often formed a thin web, and rarely the matrix was gathered into a globule terminating the capillary. Real tracheal end-cells were not seen.

As to the physiology of the luminous organ, the seat of the luminosity is at the boundary between the tracheal cylinder and the parenchyme-matrix around it: this is the place where the capillaries begin and where the osmic acid is reduced by the illumination, where oxygen is consumed. [Here we have an additional argument for the doctrine that the oxygenation of the tissues depends not on a circulatory fluid around the tracheæ, but on the activity of the tracheal terminations.] The action of osmic acid at this part is an *experimentum crucis*, proving that at the bifurcation the plasma of the parenchyme coming to meet the fine tracheal capillaries, receives oxygen from them, and hence combustion arises where the chitin of the capillaries is very thin.

Emery holds that the use of the light-producing power is not merely for attracting the rare females, but for frightening such nocturnal enemies as bats. Luciola on being crushed emits an unpleasant flavor, but its taste is not at all bitter.—*G. Macloskie.*

Entomological Notes.—A case of mimicry is noticed by C. M. Weed in the same number; *Tetracis lorata*, a white geometrid moth was found adhering to the stamens of a flower of the may-apple, its head toward the center, the wings being easily mistaken for the petals; a second one was found in exactly the same position.——E. L. Ragonot, 12 quai de la Rapee, Paris, is working out the Phycidæ and Galleridæ of the whole world, with a view of monographing these groups, and desires American specimens; European microlepidoptera will be sent in return.——At a recent meeting (July 2) of the London Entomological Society, Mr: C. O. Waterhouse exhibited various species of phytophagous beetles to show the extraordinary effect that exposure to light had produced on their colors. Fiery red had turned to bright green, pale yellow to brown, blue to black, and green to purple. The specimens exhibited had been in the public galleries of the Bristol Museum for twenty-five years.——In *Zoologischer Anzeiger*, July 7, P. Pancirtius publishes a note on the development of the wings in insects; in the same journal for July 21, E. Korschelt begins

an account of his observations on the structure of the chorion and micropyle in the eggs of insects. —— Professor A. S. Packard, Providence, R. I., desires alcoholic specimens of Poduridæ and other Thysanura with a view to a future monograph of this order. He will gladly name any specimens sent him for identification. ——Dr. Heylaerts publishes in the Compte-rendu de la Société entomologique de Belgique (p. CCVII), remarks on the Psychides of the United States. He believes that other genera of these sack-bearing caterpillars will be discovered, such as the Epichnopteryx, Bijugis and Fumea, though he adds that not an European species has yet been discovered here. He describes from Professor Riley's collection *Chalia rileyi*, and notices a series of seven cases of unknown species, all, except one from Brazil, being from the Southern and Western States and Territories.——An Asiatic species of Corydalus (*C. asiatica*) resembling in size and appearance our *C. cornutus*, is described and figured by J. Wood-Mason in the Proceedings of the Zoölogical Society of London (1884, p. 110). It occurred at the Naga hills, N. E. frontier of India. All the previously described species of this genus are American.

ZOÖLOGY.

THE DEEP SEA EXPLORATIONS OF THE "TALISMAN."—The official report by M. A. Milne-Edwards, of the last expedition of the *Talisman*, has been published and translated by the *Independent*. The expedition of 1883 was divided into several distinct steps, the aim being to examine: 1. The coast of Africa as far as Senegal, then the shores of the islands of Cape Verde, of the Canaries and Azores, and, finally, to examine the Sargasso sea and study its surface fauna as well as the nature of its depths.

In one of the first trials on the coast of Spain, the *Talisman* party found an accumulation of dead shells, having the aspect of the pliocene fossils of Sicily, and among which M. Fischer recognized *Cypridina islandica* and *Mya truncata*, which are common in boreal seas and do not live south of England. They were associated with some Mediterranean or pliocene shells. Off the coast of Morocco and the Sahara were found, at the depth of 500 to 600 meters, numerous fishes (Macrurus, Melanocephalus, Hoplostethus and Pleuronectes), crustaceans such as certain undescribed shrimps with an enormous rostrum, pointed like a sword, which was named Pandales; other shrimps of the genera Penæus, Pasiphaea, some small crabs (Etalia, Portunus and Oxyrhynchus), some red Holothurians, examples of the soft-shelled sea-urchin (Calveria), which formerly lived in the chalk formation; also many large-sized sponges, some in the shape of an enormous chapeau (Askonema), the others lamellated (Farrea), the others more or less globular.

Deeper down, toward 1000 and 1500 meters, fishes abounded;

there were still Macruri, to which may be added species of Bathynectes, Coryphenoides, Malaccocephalus, Bathygadus, Argyropelecus, Chauliodus, Bathypterois, with fins transformed into tactile appendages (*B. longifilis*), Stomias, Malacosteus, with the skin of an intense black, and with phosphorescent jugal plates; Alepocephalus, etc. All these fishes, on arriving at the surface, were dead, the gas was separated from the blood, so as to produce a sort of froth, and many of them were deformed by the enormous distention of their swimming bladder. The species of this group, which inhabit the abysses of the sea, have a special aspect, and are readily recognizable. Their skin, covered with a very thick coat, never has lively colors; it is grayish, or of a velvet black, and the scales are not very solidly attached; the muscles are not thick, and are of a soft consistence; their bones are soft and have a spongy structure; their mouth is usually large, and armed with sharp, hook-like teeth. Most of these fishes live in the ooze, or at its surface. All that were observed by the *Talisman* party had normally developed eyes, whose mode of action in a medium completely obscure would be difficult to understand, if it did not find its explanation in the existence of phosphorescent plates, or of a covering of luminous slime, which can shine at a certain distance. In the black Malacosteus these plates are situated at the eyes; in other species they are disposed in lines on the lateral parts of the body.

The Pandali have given place to the Heterocarpus, with the carapace furnished with projecting edges; to species of Penæus, whose posterior feet resemble antennæ, and to enormous shrimps of a blood-red color, and with extremely long antennæ, which were previously unknown, and should be placed in the genus Arista.

These crustacea were common, and several times they were caught in such abundance that the cook claimed his share of them. The Nephropsis appeared at this level; they are blind crustacea, which externally resemble some kinds of crayfishes, of a coral red. Their geographical distribution seems to be very extensive; for they have been found on each side of the Atlantic, in the Antilles, while a Chinese species which seems to be identical, at least very near, has been dredged at a great depth near the Andaman islands.

The Pentacheles and the Polycheles, whose eyes are atrophied, conceal themselves in the ooze, only extending their long, slender pincers adapted to seize their prey. They alone represent in actual nature the Eryons, so common in the jurassic seas.

The Nematocarcini, with remarkably long feet, live in the same conditions. The crabs have become rarer, though some species still exist. These are the Maians (Scyramathia, Lispognathus), some Homolians of a new species, Lithodes of great size, heretofore peculiar to Arctic and Antarctic seas. A very large Lithodes

was dredged by the *Talisman*, under the tropics, at the depth of 900 and 1000 meters. This species, distinct from all others yet known, has been named *Lithodes tropicalis*. There also occurred several crustacea of the group Galatheæ, whose eyes are transformed into spines.

The sponges are extremely common at the surface of the bed of this part of the ocean. Most of them, as well known, have a silicious skeleton.

Several species of the beautiful Rosella and of Holtenia were found living in profusion. Their long hairs of white silex are buried in the mud, and the sponges, with a form like a rounded vase and a narrow orifice, project above the mud. They were especially numerous between 900 and 1200 meters, and at certain points they seem to form veritable beds. The Aphrocallistes, whose solid framework, composed of regular cells, affects the most elegant forms, and gives the appearance of a honeycomb, form extensive banks; they were found ordinarily associated with, and attached to, branching corals of the genera Lophohelia and Amphihelia.

The soft sea-urchins, such as the Calveria, become more numerous, and at 1000 meters they probably live crowded together like the Echini of our shores. Some Holothurians, of the genus Loetmogone, and other species of the same family creep among them; numerous starfishes, Ophiurans and Brisingas, are also associated there. Otherwise the fauna changes according to the nature of the bottom, and where the mud gives a foothold to the polyps, we find in these new conditions a different population.

Off Cape Ghir and Cape Noun, under the 30th parallel, at 120 miles from the shore, the *Talisman* explored, for several days, a very regular bank, whose depths only varied between the narrow limits of 2075 to 2300 meters. It was on this same bank that, on the 2d of August, 1882, the *Travailleur* brought up in its nets the singular fish described by M. Vaillant under the name of *Eurypharynx pelecanoides*, associated with a great number of new or rare species. This year two specimens of Eurypharynx have been captured, one at 1050 meters and the other at 1400 meters, on the bottom of the reddish ooze west of Morocco. Similar banks, but less rich, had been already explored by the *Talisman* on the Morocco coast, off Rabat, between Cape Blanc, northerly, and Cape Cantin, a little before the arrival of the *Talisman* at Mogador. These were found again under the 24th parallel; also off the Arguin bank. At this depth, the fishes were represented by some very rare species, such as the *Melanocetus johnsoni*, which had been as yet known only by a single example found floating on the water by fishermen near Madeira. With its enormous mouth it could swallow a fish considerably larger than its own body, and its prey would lodge in a sac which hangs below its abdomen. The first ray of the dorsal fin is developed into a true

tactile appendage, recalling that of the anglers, and serving the same purpose. Some Bathytroctes, a Stomias with phosphorescent plates, several Malacostei and some Halosaurus live also on the same oozy bottom. Many Crustacea, new to science, were here dredged, and belonging principally to the group of Galatheæ of the genera Galathodes, Galacantha, and Elasmonotus, whose eyes, deprived of any cornea, are covered with an orange colored pigment, and should be useless for vision. With them were dredged several new kinds of mollusks, among them a Dentalium of large size (*D. parfaiti*) and a Pholadomiya.

Between Senegal and the Cape Verde islands, the bottom, at a depth of from 3210 to 3655 meters, consisted of a greenish mud rich in life. Some of the animals found there did not differ from those found on the bank situated at the depth of 2300 meters.

Others presented peculiar characteristics. These were fishes of the genus Bathynectes, Synaphobranchus, and Myrus, some Aristes, with bright colors and very like those at depths of from 1000 to 1200 meters, but with smaller eyes. Among Crustacea were Pasiphaës, hermit crabs and Mysidæ. Among mollusks were a new species of Bulla, and another gasteropod belonging to an unknown genus (*Oocorys sulcata* Fischer); among Echinoderms were species of Ctenodiscus, Ophiurans, and species of Ophiomusium.

Between St. Antoine and St. Vincent the fauna surpassed in richness any regions previously explored. July 29th, at a depth of from 450 to 600 meters, the dredge came up at the end of an hour charged with more than a thousand specimens of fishes belonging mostly to the genus Malacocephalus; with more than 1000 Pandali, 500 amphipods, with long feet, a new species of Nematocarcinus, 150 Pasiphaës spotted with red, large carmine-red Aristes, and many other forms.—*To be continued.*

The Depth to which Sunlight Penetrates Water.—The much-discussed question as to the depth to which sunlight penetrates water, and the influence which such penetration, or want of penetration, may exert upon the phenomena of life at great depths has attracted renewed attention of late on the part of both physicists and biologists. The carefully conducted observations of Professor F. A. Forel, of Geneva, made upon the Lake of Geneva in 1874, proved—at least as far as the resources of photography and the human retina permitted—that the limit of absolute darkness in that lake was reached in summer at the very moderate depth of 45 meters, and in winter at 100 meters. Under normal conditions of sight a shining object disappeared when immersed below 16 to 17 meters. Asper, who continued the researches of Forel upon the Lake of Zurich, found in 1881 that photographic plates sensitized with bromide of silver emulsion indicated the penetration of light to at least 90 meters. But while the researches here recorded fix the limit of luminous perception as

dependent upon the powers of the human retina, they do not necessarily determine the same for the retina and visual nerves of the lower animals. Indeed, the presence of well-developed eyes in many of the animal forms inhabiting the greatest depths, no less than the varied coloring of their teguments, have frequently been taken in evidence to prove not only the existence of light there, but also the unequal visual powers of the different organisms. Professor Verrill has recently enunciated the startling proposition that not improbably light of the intensity of ordinary moonlight may penetrate to depths of 2000, or even 3000 fathoms, and that possibly some sunlight penetrates even to the lowest bottom of the ocean. Evidently, however, the tegumentary coloring as we observe it has no bearing on the question at issue, inasmuch as it appears as such only when brought within the influence of white light, which may be at, or quite near to, the surface of the water. Whether or not the quantity of phosphorescent light emitted by the organisms themselves is sufficient to account for the full development of visual organs, still remains to be proved. In the meantime, the recently conducted investigations of a special committee of Swiss scientists, among whose names we find those of Sarasin, Soret, Pictet, C. De Candolle, and Fol, seem to affirm in a general way the conclusions reached by Forel—namely, that luminous penetration extends to only moderate depths. Three candles (contained in a lantern), immersed in the clearest water of the Lake of Geneva, were visible at a depth of 30 meters; and an electric light, at 3 meters further. The distance of clear vision was found to be but very feebly dependent upon either the increase of brilliancy in the luminous body, or its absolute magnitude. The extreme limit of the sun's luminous action was determined photographically to be 250 meters, beyond which absolute darkness was supposed to prevail. —*The Nation.*

On the Structure of the Brain of Asellus and the Eyeless form Cecidotæa.[1]—The results presented grew out of an attempt to compare the nervous system, particularly the brain and other cephalic ganglia, of the eyeless species of cave-inhabiting Crustacea and insects with the allied eyed forms. After describing the brain and organs of sight of the common water sowbug (*Asellus communis*), with it was compared those of the blind asellid, *Cecidotæa stygia* Packard, which is so common in the brooks of Mammoth and other caves, and in the wells of southern Illinois and Indiana. Studies of this nature seem well calculated to throw light on the origin of the cave forms, and to show what great modifications have been produced in these organisms by a radical change in their surroundings; consisting as the latter do mainly of the absence of light and perhaps of the usual food, or at least the usual amount of food.

[1] Read at the Newport Meeting of the National Academy of Sciences, Oct. 4, 1884.

After describing the hitherto unknown peculiarities of the brain of Asellus and isopod Crustacea in general, the histological elements, and the optic lobes, nerves, and eyes, the brain of the eyeless forms was then described. Cecidotæa in its external form is a somewhat dwarfed Asellus, with the body, however, much longer and slenderer than in the eyed forms, and with slenderer appendages. It is not usually totally eyeless, since in some individuals a rudimentary eye, in the shape of a minute black speck, is seen on each side of the head; the spot varying in size in different individuals.

From the examination of numerous microscopic sections it appears that the eyeless Cecidotæa differs from the eyed form (Asellus) in the complete loss of the optic ganglia, the optic nerves, besides the almost and sometimes nearly total loss of the pigment cells and lenses. As regards the other parts of the brain, no differences were observed; the proportions of the brain and the histological structure had remained unchanged in the eyeless forms. Besides the atrophy of the optic ganglia and nerves, the pigment mass forming the retina and also the lenses exist in a very rudimentary condition. In one specimen the number of lenses was reduced to two, and the lenses themselves many times smaller than in the eye of the normal Asellus.

The steps taken in the degeneration or degradation of the eyes, the result of living in perpetual darkness, seem to be these:

1. The total and nearly or quite simultaneous loss by disuse of the optic ganglia and nerves.

2. Breaking down of the retinal cells.

3. The last step being, as seen in the totally eyeless forms, the disappearance of the lens and retina.

That these modifications in the eye of the Cecidotæa are the result of disuse and the loss of the power of vision from the absence of light seems well established; and this, with the many parallel facts in the structure of other cave Crustacea, as well as insects, arachnids, and worms, seemed to the author to be due to the action of two factors: (*a*) change in the environment and (*b*) heredity. Thus one is led by a study of these instances, in a sphere where there is little if any occasion for the exercise of a struggle for existence between the organisms, to a modified form of Lamarckianism in order to account for the origination of these forms, rather than the theory of natural selection, or pure Darwinism, as such.—*A. S. Packard.*

On the Morphology of the Tarsus in the Mammals.—While occupied with an extended paper on the limb-skeleton of the vertebrates, I have obtained some new views on the homology of the tarsal elements in the Mammalia. For some time I have been puzzled by a bone in the tarsus of different mammals, which has always been considered a "*sesamoid.*"

Flower (Osteol. of Mamm., 2d edit., p. 317) says of this bone:

"There is a large sesamoid bone on the tibial side of the tarsus, articulating with the astragalus, navicular and internal cuneïform."

Gegenbaur, who has done so much for the morphology of the limbs of vertebrates, says in regard to this:[1]

"EineVermehrung der Tarsuselemente ist bei Nagethieren vorhanden, von *Cuvier* wie von *Meckel* ausführlich beschrieben. Es wird dieseVermehrung aus einer Theilung des Naviculare abgeleitet und aus dem Hinzutreten eines überzähligen Knochens, der am inneren Fussrande des Cuneiforme 1 angelagert ist. Der aus der Theilung des Naviculare entstehende zweite Knochen liegt gleichfalls am inneren Tarsus rande, hinter dem vorhin erwæhnten, ist dem Kopfe des Astragalus seitlich angefügt und stösst überdies noch mit dem eigentlichen Naviculare und auf eine kurze Strecke mit dem Cuneiforme 1 zusammen. Wenn auch seine Lagerung am Astragalus und seine Verbindung mit dem eigentlichen Naviculare die Ansicht von seiner Entstehung, wie sie die oben genannten Autoren äussern, als sehr wahrscheinlich erscheinen lassen, so halte ich sie doch noch nicht für fest begründet. Das Vorkommen des zweiten Knochens, sowie ähnlicher überzähliger Stücke am Tarsus der Monotremen schliesst die Möglichkeit nicht aus, dass auch das aus einer Theilung des Naviculare entstanden sein sollende Stück ein Accessorium ist. Daran wird wenigstens so lange festgehalten werden dürfen, bis der Nachweis einer Theilung der Naviculare aus der Entwicklung geliefert ist."

I do not consider this bone a sesamoid for the following reasons:

1. Its situation. It articulates by distinct and well-developed faces with the first cuneïform (Tars. 1), at the proximal prolongation of which it is situated, and with the navicular and astragalus. In many *rodents* it articulates with the entire surface of the first cuneïform.

2. Its origin. In Cavia it is always found equally developed with the other tarsal bones and quite distinct.

3. Its relationship in certain phylogenetic old rodents, Cercolabes and Erethizon. In these forms there is always developed a claw-like piece of bone, articulating with the "sesamoid" in question, and hence it loses all the characters of a "sesamoid." It is surrounded by the astragalus, navicular, cuneïform 1 and the claw-like piece.

G. R. Waterhouse (A natural history of the Mammalia, Vol. II, Pl. 18, Fig. 4) gives an excellent figure of the tarsus of *Cercolabes novæ hispanæ*, but he calls these elements "supernumerary bones" (pp. 405–406).

Let us examine the relationship of this bone in some other orders

[1] Gegenbaur, C. Untersuchungen zur vergleichenden Anatomie der Wirbelthiere, 1 Heft. Carpus and Tarsus. Leipzig, 1864.

of mammals. In Hyrax I find a small bone between the astragalus and navicular, which I can only homologize with the "sesamoid." In the carnivores it appears to be coalesced with the navicular, as in Lepus, for I always find in the ascending part of the navicular traces of a former separation. In an embryo of a dog of 65^{mm} I have observed indications of a former distinction. In a recent examination of Ornithorhyncus[1] I have observed the same condition as in Cercolabes; the spur of the former is homologous with the claw-like piece in this rodent. A similar condition is found in many Edentates.

The question now is, what is the homologue of this bone? I can only compare it with the tibiale. The astragalus would then be homologous with the intermedium, the calcaneum with the fibulare.

I reach the conclusion: First, by the position of the piece in question; it lies in the first row of tarsal bones next to the astragalus; second, by the development of the tarsus of mammals. I never have been able to distinguish an "intermedium" in the sense of Bardeleben. In embryos of mammals, I have always found the astragalus composed of one piece, and I never find an element between the astragalus and calcaneum. In adult mammals, especially in Marsupials, I find Bardeleben's "intermedium" well developed, but I only consider it a tendon ossification.

The terminology of the tarsus of mammals would be the following:

Tibiale	=	Sesamoid.
Intermedium	=	Astragalus.
Fibulare	=	Calcaneum.
Centrale	=	Naviculare (Navic. = Centr. + Tib.).
Tarsale I	=	Cuneiform I.
Tarsale II	=	Cuneiform II.
Tarsale III	=	Cuneiform III.
Tarsale IV + V	=	Cuboideum.

If we seek for connecting forms among the vertebrates below the mammals, we must bear in mind the Theromorpha from the Permian recently described by Cope, which show so many resemblances to the mammals, especially in the tarsal bones. I do not hesitate to consider the claw-like piece in the tarsus of Cercolabes and Erethizon and the spur in the monotremes as the rudiment of a sixth toe, and would like to compare it with the same structure seen in the tarsus of frogs.

In my paper on the morphogeny of the carpus and tarsus of the vertebrates I will speak further on this subject.—*Dr. G. Baur, Yale College Mus., New Haven, Conn., Oct., 1884.*

ZOOLOGICAL NOTES.—*Cœlenterates.*—Messrs. Koren and Daniellsen have recently described fifteen new species of Alcyona-

[1] Cope, E. D., Paleont. Bull. No. 39, p. 46, 1884.

rians, most of which have been dredged in the Bergen and Drontheim fjords. The new genus Duva contains four species. It contains much branched forms, bearing several non-retractile polyps at the extremity of each branchlet. The polyps are provided with long acicular spicules, and branches, twigs, and septa are without calcareous deposit. *Gorgonia florida* Rathke belongs to this division. Another new genus Gondu, is so peculiar that it is considered the type of a new family of Pennatulids and even of a section of the order characterized by the fixity of the rachis, the presence of long calcareous spicules and the bilateral development of the pinnules. The colony is short and without a base. The spicules have a central canal, divided into four by septa. The only species, *G. mirabilis*, is of a beautiful orange, with dark red polyps. The remaining species belong to the alcyonarian genera Sarcophyton, Gersemia, Clavularia, Sympodium, and Haimea, the gorgonian genera Brianeum and Paragorgia, and the pennatulid genera Gladiscus, Kophobelemnon, Leptotilum and Pinnatula.

Worms.—M. J. G. de Man, of Leyden, has published a monograph of the nematodes of the Netherlands and of France. He describes forty-three species belonging to thirty-six genera, of which twenty are new. Terrestrial nematodes can usually be found in the earth attached to the roots of damp grass, and fresh created species abound upon the filaments of Confervæ and in the detritus of ponds and brooks.

Crustaceans.—Crustacea seem to be rare in Barentz sea, for the six Dutch expeditions have only obtained fifteen species. M. Weber, in the *Niederländische Archiv fur Zoologie*, gives a careful description of *Glyptonotus sabini* Kroyer.

Fishes.—Cases of hermaphroditism among fishes accumulate. Aristotle first noticed it among the Serranidæ, and his statements have been since verified. The peculiarity has been observed in three or four species of Serranus, and in sixteen other species of bony fishes, viz: *Box salpa*, *Charax puntazza*, *Chrysophrys aurata*, *Labrus mixtus*, *Pagellus mormyrus*, *Perca fluviatilis*, *Sargus annularis* and *S. saloaini*, *Scomber scomber*, *Gadus morrhua*, *G. merlangus*, *Lota vulgaris*, *Solea vulgaris*, *Clupea harengus* and *Cyprinus carpio*. The majority of these species are Physoclysti, but three are Physostomes. Hermaphroditism has also been observed among the Chondrostei (*Acipenser huso*, *A. sturio*), but not among the elasmobranchs or the dipnoans. In examples of *Centrolophus pompilio*, *Smaris alcedo*, and *Ophidium barbatum*, a mass of ovules has been seen to develop within the male gland in the midst of the spermatoblasts. M. Max Weber (Ueber Hermaphrodismus bei Fischen. Nied Tijd. vor der Dierkunde) gives an interesting anatomical description of twò hermaphrodite fishes, a perch and a cod. He attributes hermaphroditism to the primordial sexual indifference

of the materials at the expense of which the genital glands are developed. This makes it possible that, while one part of these embryonic materials evolves the male sex, the other may suffer modifications in the direction of the female.

Reptiles.—The lizards of the genus Macroscincus, which are not known to occur on any other spot than the desolate volcanic islet of Branco, three and a half miles south-west of Santa Lucia (Cape Verde islands) are said by M. A. Milne-Edwards to be exclusively vegetable feeders of exceedingly timid disposition. They live in holes among the loose basaltic masses which strew the island. The largest example obtained by the naturalist of the *Talisman* was sixty centimeters in length.

Birds.—The report of the committee for obtaining observations of the migrations of birds at light-houses and light-vessels around and near the British islands, contains much interesting information. Light-vessels moored from five to fifty miles off shore are most favorably placed for such observations. At Heligoland, the rush of migrating birds is more marked and concentrated than anywhere on the English coast. The great rushes on the English east coast in 1883 were on September 21 and the two following days, with moderate cross-currents of air blowing over the North sea, on October 12 and 13, and from the 27th to the 31st of the same month. No less than eight Greenland falcons were shot on the west coast of Ireland during the past year. Not a tithe of the enormous immigration of the autumn returns by the same lines in the spring.

Mammals.—M. A. Milne-Edwards stated in 1871 that, as a result of an examination of the foetal development of Indris, Propithecus, and Lemur, he had concluded that the lemuroids had incontestable affinities with the herbivores. Since that epoch, M. A. Milne-Edwards has examined the embryos of Microcebus, Galago, etc., which yielded the same results, and lastly has dissected a foetus of the aye-aye. This was found to resemble in every essential character those of other lemuroids, while the foetal membranes were those of a typical lemur. The dentition of the young aye-aye is much less different from that of other lemurs than that of the adult, in consequence of the shedding and non-replacement of some of the milk-teeth. The abnormal characters of the species are developed as age advances.

EMBRYOLOGY.[1]

AN OUTLINE OF A THEORY OF THE DEVELOPMENT OF THE UNPAIRED FINS OF FISHES.[2]—The median fins of fishes normally present five well-marked conditions of structure which correspond inexactly to as many stages of development, which, in typi-

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

[2] To appear in full in the Proceedings of the National Museum, with plates.

cal fishes, succeed each other in the order of time. A sixth exceptional form is developed in consequence of an extensive degeneration of the chordal axis and hinder end of the urosome, unaccompanied by an upbending of the hinder end of the axis, as in the case of the evolution of heterocercy. The most primæval stages, or those found to appear in the younger phases of the growth of fishes are somewhat approximated by the structure of the fins of some of the most ancient Devonian, Triassic and Jurassic forms and by such living forms as Chimæra, the Dipnoans and Leptocardians, but the parallelism of the development of the tail of young fishes with the successive modifications of caudal structure found in the forms of successive geological periods is not exact, as we shall presently show.

1. *Archicercy.*—The most primitive modification of the urosome is that which I will call *archicercal*, and which is without any median fin-folds whatsoever. While it is true that only a few degenerate or specialized forms of true fishes (Hippocampus, Nerophis) approximate such a condition, it must be admitted that the fins are acquired structures, and that the folds from which they are developed have been acquired in the course of the evolution of the ancestry of the fishes. When a young fish is developing in the egg its tail grows out at first as a blunt prolongation backwards, which is for a time wholly without fin-folds, cylindrical and vermiform in general appearance, with the muscular somites clearly marked.

The larva of Branchiostoma (Fig. 1) is at first without median

Fig. 1.

fin-folds, and that of Petromyzon seems to be without them during the very early stages, and while we must make due allowance in both these cases for the effects of degeneration, we may, I think it probable, look upon these types as possessing at one stage a typically archicercal and vermiform tail. The solitary Urochorda or Ascidians pass through an archicercal stage of development of the urosome. In the course of further development the Ascidians never seem to pass beyond what I have called the second or lophocercal stage when it is absorbed in the caducichordate forms, but persists in the same stage in the perennichordate Appendicularia.

The Elasmobranchs seem to pass through an archicercal stage while the Amphibians do not exhibit it in so pronounced a way, very soon becoming lophocercal, though the larva of Dactylethra has the anterior part of the urosome with high median fin-folds while the termination is somewhat like that of *Chimæra monstrosa* (Fig. 2), but tapers more and is typically archicercal (*teste*, W. K.

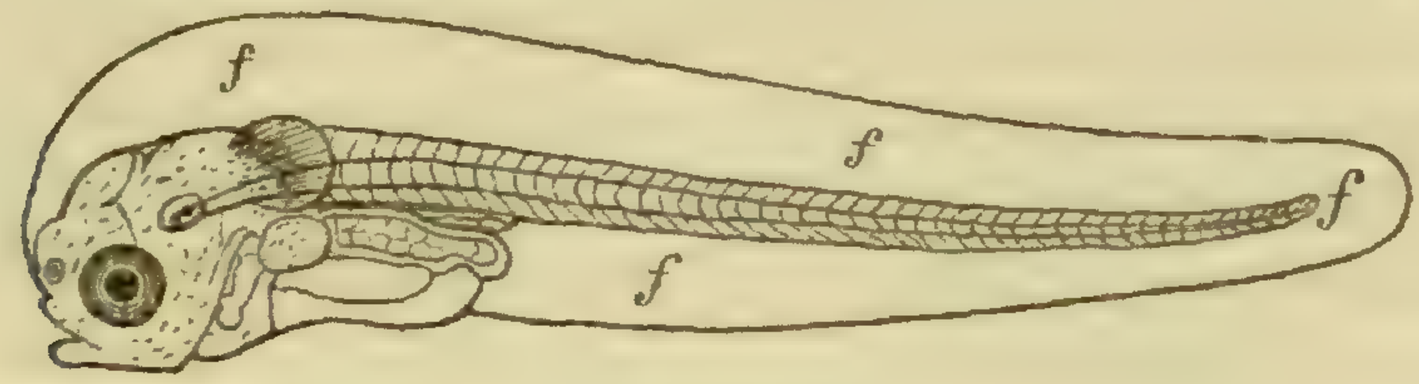
Parker). After the absorption of the lophocercal tail of anurous amphibian larvæ has been in progress for some time, it seems to

Fig. 2

tend to lose its median folds somewhat and revert to the archicercal condition. This is also the case with the young of most Urodela as they approach maturity.

2. *Lophocercy*.—The second stage of development of the median fin-system of Ichthyopsida is what I have called *lophocercal* (= *protocercal*, Wyman; = *leptocardial*, A. Agassiz) when it consists of continuous folds (Amphibia, Elasmobranchs, Teleosts, etc.), or exceptionally of discontinuous folds (Siphostoma, Gambusia) which do not include permanent rays. The continuity of the median fin-fold in young fishes seems to depend somewhat upon the extent to which the permanent fins are approximated in the adult. Several forms amongst the Clupeoids develop an expanded eradiate caudal fold, with the chordal axis dividing it into equal moieties, which anticipates the form of the outwardly homocercal tail of the adult. At the close of the lophocercal condition the ray-bearing fishes at once diverge from the rest of the Chordata, and also the Urochorda, in that they develop *embryonic rays* in definite regions of the median fin-fold or continuously throughout its entire extent and which give rise to the rays of the distinct or continuous fins of the adult. The intervening parts of the fold in the first case atrophy (—local reversion to archicercy),

Fig. 3.



the materials for the formation of the rays being supplied partially by mesoblastic secretion, while the axial parts are of mesoblastic origin; the materials for the medulla of the rays being supplied by the outgrowth of mesoblast into the fold. The disposition of the materials for the development of the rays of the unpaired fins seems to be very decidedly under the control of heredity, which determines their permanent location or position in

the primitive fold, which may therefore be considered the matrix of the permanent fins.[1]

In the formation of rays, their supports and musculature, there is clearly a close correspondence between the number of ray-bearing somites of the body and the one, two or three rays and supports which are developed to each segment, and this is manifested even when heterocercy and its accompanying degenerative processes manifest themselves in the caudal region of the most specialized forms.

3. *Diphycercy.*—The most archaic distribution of the median fin-rays is a continuous one, (as in Fig. 4), and is hypaxial from the vent to the end of the tail and then forward dorsally or epaxially; (Cœlacanthi, Placodermi, Dipnoi, Pleuracanthus). Another archaic trait is the perfectly straight chorda or vertebral axis which extends without upward curvature in typically diphycercal forms to the end of the urosome. (An archaic trait which also marks a phase of the ontogeny of the Teleosts is the Cœlacanthous—hollow—condition of the bony portion of the spines and their supports.) Fishes with a long eel-like body have tended to remain diphycercal, while those whose bodies have been abbreviated have tended, with the exception of such forms as the Heterosomata, to develop discontinuous median fins which have very probably been derived in the first instance, from hypertrophied portions of a continuous series. This hypertrophy in some cases involved the whole series, e. g., Platax. The primæval pre-diphycercal or lophocercal condition is mediately followed by the next stage (Fig. 5) which, as we have seen, must have been developed from a more archaic condition or one of true diphycercy. There therefore occurs a more or less extensive elision or failure to develop a continuous series of rays when specialization sets in so as to produce a discontinuous system of median fins. Embryonic development therefore fails to exactly recapitulate the phases of evolution of the median fins. Even the embryonic rays which are of mesoblastic origin do not always form a continuous series. They are far more numerous than the permanent rays, and are characteristic of the diphycercal condition and represent a stage of fin development which may be called the *protopterygian.*

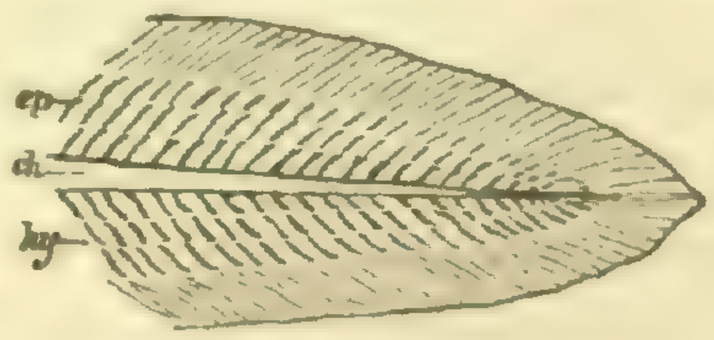


Fig. 4.

Fig. 5.

These views are fully substantiated by the development of the caudal skeleton of the eel, in which in spite of its slight hetero-

[1] Another article in the succeeding number will deal with the origin of the fin-rays.

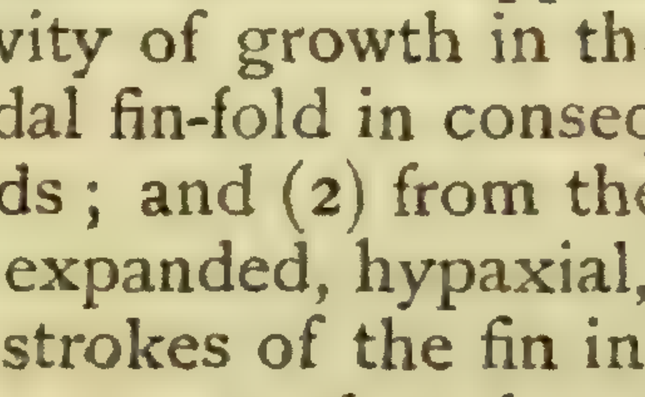
cercy the diphycercal continuity of the fin-series has remained practically unimpaired, thus affording the necessary proof of the *serial homology* of the entire series of median fin-rays and their intermediary supports. (Previous authors failing to attack this part of the problem by the light of the ontogeny of a diphycercal eel-like type have missed the solution of one of the most important minor parts of a rational theory of the median fins, since it is otherwise impossible to prove such a homology in forms with atrophied intervals between the vertical fins.) The mesoblastic skeletogenous tract from which the median fin-rays and their supports are developed, is continuous in the median line of the urosome, above, below and almost over the end of the chorda in fish embryos; such a continuity affords an explanation of why the median fin-rays form an uninterrupted series in cases of perfect diphycercy (Fig. 4), or where the archaic has not been replaced by a specialized mode of development, in the course of which discontinuity has arisen (Protopterus).

4. *Heterocercy.*—Heterocercy affects only the end of the chordal axis, which is bent upwards, and as a result of this it and the subsequently formed terminal vertebral segments are consolidated into a urostyle (many Teleostei), above and below which epaxial and hypaxial skeletal elements are formed, of which the former are, however, often aborted, and the latter widened as supports for the caudal system of rays.

This condition appears to result from two causes: (1) Great activity of growth in the terminal hypaxial part of the primitive caudal fin-fold in consequence of which the chorda is shoved upwards; and (2) from the *actions* of the animal in using the resulting expanded, hypaxial, caudal, ray-bearing fold in swimming; the strokes of the fin in action, owing to the resistance offered by the water, tend to throw up the somatic axis, just as an oar tends to be thrown upward in sculling.

Since the hypaxial fold may be developed at some distance from the end of the tail, in the more specialized forms (Lepidosteus, Fig. 6; Gasterosteus) a more or less extensively free portion

Fig 6.



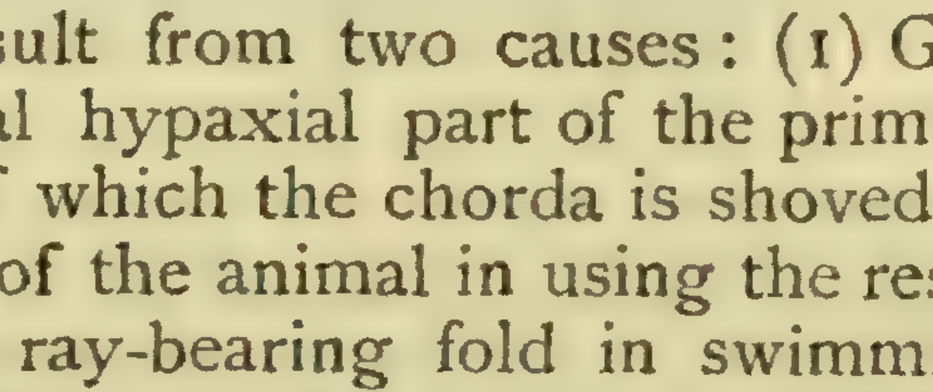


Fig. 7

of the lophocercal caudal axis is left to project (Fig. 7) during the growth of the true or secondary caudal, the rays of which are mostly hypaxial and serially homologous with those of the anal. The exserted part of the larval axis alluded to above, may be called the *opisthure*, in reference to its position in relation to

the permanent caudal. It subsequently degenerates, or it may persist as a prolongation of the chordal axis covered by integument, as in *Chimæra monstrosa* (Fig. 2) or, as in heterocercal Amiurus (Fig. 8), it may, at an early stage, have the chorda exserted beyond the last hypural cartilages and at some distance behind them have another hypaxial cartilage (*op*) developed, which may be called opisthural, as it probably represents the remnant of proximal hypural pieces, which were developed in some more primitive ancestral form in which diphycercy was more pronounced or even perfect. Where the caudal, ray-bearing finfold is developed nearer the end of the chordal axis (Apeltes, Siphostoma, Gambusia,) heterocercy is not so pronounced, as the urostyle is shorter and only one or two of the terminal vertebræ are involved, whereas in other cases (Salmo, Lepidosteus) more terminal vertebræ may be implicated by degeneration. In archaic forms of heterocercy there may be epaxial rays and intermediary supports developed, while the hypaxial supports and rays extend to the end of the upwardly bent termination of the axial column (Fig. 5). This trait may possibly differentiate the archaic type of heterocercy (Palæoniscus, Platysomus, Acipenser, Squali) from the more recent or specialized form (Amiurus, Fig. 8) now prevalent amongst Teleosts, and which have for the most part a more or less well-developed urostyle, but with a very short or included opisthure (= dorsal lobe, A. Agassiz), and with the epaxial spines of the urostyle displaced, rudimentary or aborted. Outwardly homocercal Palæozoic fishes (Dapedius, Pycnodus,) probably had an opisthural filaments developed during their larval stages which subsequently became aborted, as in Lepidosteus, but in others (Platysomus, Pygopterus,) the terminal part of the chordal axis doubtless became segmented, the segments bearing hypaxial caudal rays and few or no epaxial ones, so that their opisthures were probably rudimentary or wanting.

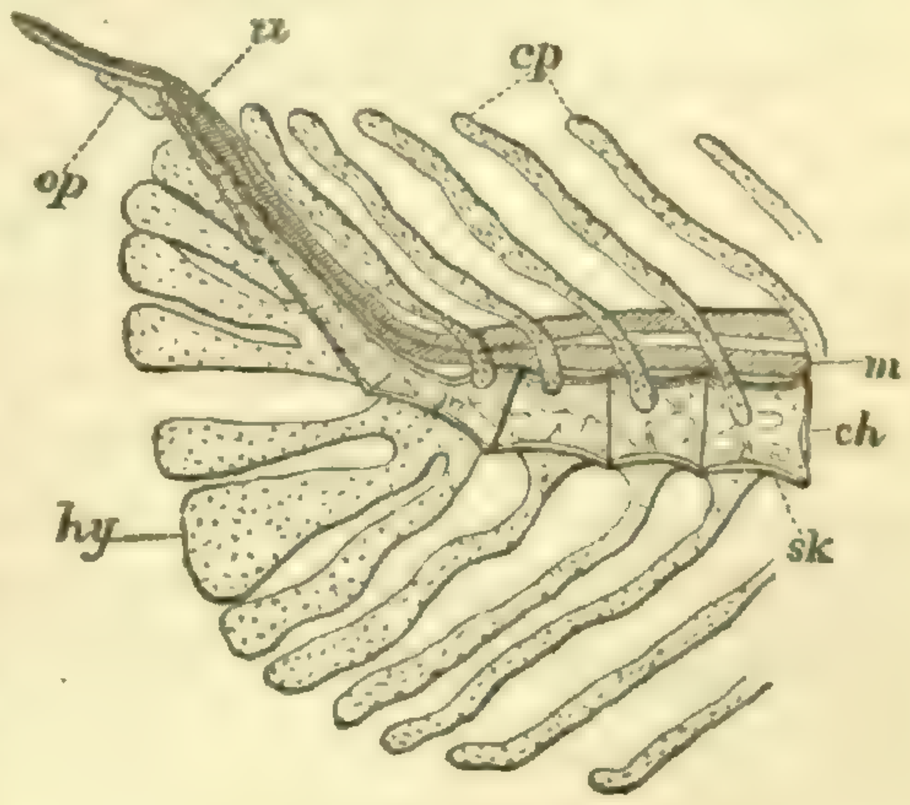


Fig. 8.

It thus becomes evident that the development of modern Teleosts presents only a partial or inexact parallelism with that of the Palæozoic Rhomboganoidei, for few, if any, of these forms show the urostyle so distinctly developed or the hypural pieces so extensively coössified as in existing Teleostei, and we have also shown that there is no such thing even as an exact parallelism to be discovered between the development of the tail of the embryos of the latter and that of the embryos of an existing representative of Palæozoic forms, viz., Lepidosteus (Fig. 6). The Rhom-

boganoidei, Cycloganoidei, Crossopterygia and Chondrostei show a more decided tendency towards the development of a dorsal and ventral, or, only a ventral series of caudal rays which extend to the end of the caudal axis, and thus trend more towards a diphycercal condition than the existing Teleostei, which may be said to be verging towards *hypocercy* when all of the caudal rays will be of hypaxial origin, with very often a rayless interval between the last hypaxial pieces and the end of the exserted urostyle (Fig. 8), the latter finally tending to become shorter and be aborted as in Fistularia and Apeltes. These are some of the marks of progress which distinguish the Teleosts and supplement the significant fact of their well-ossified skeleton. It is highly probable that we shall find no remains of the larvæ of Palæozoic fishes in the rocks, so that we have no means of contrasting their early phases with those of existing forms, but it is certain that none of the most simple forms of the Palæozoic fishes, in respect to their caudal skeletal structure, even approximate such a primitive condition as the lophocercal stage of modern forms; the only trait which they possess in common are the continuous median fins; in the first instance containing rays, in the latter case being without them. When we know the larvæ of Ceratodus, Polypterus, Lepidosiren and Protopterus, as well as we know that of Lepidosteus we may have a moderately comprehensive understanding of the main features of the development of Palæozoic fishes.

The evidence in favor of degeneration of portions of the caudal region of fishes is the existence of a permanent archicercal opisthure in *Chimæra monstrosa* and *Stylephorus chordatus;* the extensive development of a temporary opisthure in Lepidosteus; the concrescence of the hypural pieces; the ventrally diplacanthous and even triplacanthous caudal vertebræ (Fig. 8), or their coalesced representative, the urostyle; the existence of hypaxial opisthural elements; the abortion of the epaxial spines of the caudal vertebræ, and finally the abortion or extreme modification of the last muscular somites of the caudal region.

5. *Homocercy.*—This merely expresses the condition of epaxial and hypaxial symmetry presented by the fan-shaped caudal of Teleosts, and is the final term in the evolution of the growth of the rays of that fin, in consequence of which the archaic symmetry of perfect diphycercy becomes again restored, though the axial structure of the tail is heterocercal.

6. *Gephyrocercy.*—This type of tail appears to be normally met with in only two forms of Teleosts, viz., Mola and Fierasfer. The primitive opisthure or end of the urosome in these forms is apparently aborted, in the first, in the course of larval existence, in the other during post-larval life. As a result of this a hiatus is left between the epaxial and hypaxial rudiments of the median fins, and in the center of this hiatus the axial column ends

abruptly as if cut or bitten off, the hinder hypaxial and epaxial tissues concerned in the formation of rays and their supports are then approximated over the end of the aborted axis so as to form a continuous chain, and developed later than the other and more anterior median fin-rays (Mola), and the interval so bridged by a secondary process of development leads to the formation of what we may call a gephyrocercal tail, in which the spinous axial apophyses of the caudal vertebræ, together with their centra, fail to develop, and the caudal rays rest either upon interspinous elements alone, or even these may be almost entirely aborted, as is the case for a time in the young stages of Mola "*Ostracion boöps*" and "*Molacanthus*," both of which are evidently young, post-larval phases of that form.

The views here outlined rest partly upon facts of my own observation, but I must express my great indebtedness to the researches of L. and A. Agassiz, Vogt, Lotz, Balfour, Parker, Huxley and Kölliker, whose labors have enabled me to coördinate the facts and establish doctrines respecting the origin of the median fins, which are founded upon the theory of ontogeny.—*John A. Ryder. Nov. 3d, 1884.*

EXPLANATIONS OF FIGURES.

FIG. 1.—Larval Branchiostoma, (after Kowalevsky); almost perfectly archicercal.

FIG. 2.—*Chimæra monstrosa*, with an archicercal opisthural filament, (after Agassiz).

FIG. 3.—Lophocercal larva of the codfish, with continuous median fin-fold, *ffff*.

FIG. 4.—Ideal diphycercal tail, nearly as in Ceratodus and Protopterus.

FIG. 5.—Ideal archaic heterocercal tail, somewhat as found in sturgeons and sharks.

FIG. 6.—Heterocercal tail of larval Lepidosteus (after Balfour and Parker), showing epural and hypural pieces undeveloped at the end of the chorda.

FIG. 7.—Tail of a very young Lepidosteus (from the same source), showing the opisthure, *op*, above the secondary or true caudal, *sc*.

FIG. 8.—Caudal skeleton of a larval Amiurus, fifteen days old. *op*, opisthural, *hy*, hypural, and *ep*, epural cartilages; *u*, urostyle; *m*, medulla spinalis; *ch*, chorda, invested by the skeletal tissue, *sk*, of the caudal vertebræ.

PHYSIOLOGY.[1]

THE THERAPEUTIC EFFECTS OF OXYGEN AND OF OZONE.—It is a popular error that breathing pure oxygen would prove destructive to animal life by greatly accelerating combustion in the body as it does of the fuel of an ordinary fire. Filipow has lately submitted the question of the physiological action of oxygen and ozone to exact experiment on men and dogs; his results may be summed up as follows: 1. Breathing pure oxygen is followed by no effects which distinguish its action from that of pure atmospheric air, at least as regards pulse, respiration and body temperature. 2. In cases of poisoning with chloroform, alcohol, sulphuretted hydrogen or carbonic oxide, respiration of pure oxy-

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Mich.

gen offers no advantages over that of pure air. 3. Breathing in diluted ozone is without the narcotizing effects which some ascribe to it. 4. Respiration in concentrated ozone produces powerful irritation of the mucous membrane, and is therefore injurious. 5. There is no proof that ozone is taken into the blood through the lungs.—*Pflüger's Archiv., Bd. 34, S. 335.*

THE PRESENCE, SOURCE AND SIGNIFICANCE OF SUGAR IN THE BLOOD.—Seegen publishes an interesting contribution to the much discussed question of the function of the liver in relation to carbohydrates. As is well known, Bernard and his followers regarded the liver as the sugar-making organ, and went so far as to maintain that the sugar thus formed was produced chiefly by the disruption of albuminous material. Pavy and others regard, in general, the liver as a sugar destroyer, by whose means the overloading of the blood with absorbed carbohydrate is prevented. Seegen lends his support to the older school. He shows that sugar formation in the liver is a general physiological function shared by widely different groups of animals, herbivorous and carnivorous. He finds, moreover, that the liver, even when excised, has the power of producing sugar from peptone. Numerous researches on dogs gave the following principal results: 1. Sugar is a normal constituent of the blood, but varies in its proportions from 0.1 per cent to 0.15 per cent. 2. The sugar content of the blood in the right and left sides of the heart is the same. Differences between the proportion of sugar in arterial and venous blood are not constant but variable within narrow limits. The blood of the portal vein, however, nearly constantly contains less sugar than that of the carotid artery. 3. The blood which leaves the liver contains double the quantity of sugar held by that entering it. The mean of thirteen experiments gave for blood of the portal vein, sugar 0.119 per cent; for the hepatic vein, sugar 0.23 per cent. 4. The amount of sugar thus leaving the liver in the course of a day is very considerable. The amount produced by the dog's liver in twenty-four hours is calculated to vary from 200 to more than 400 grammes. 5. The blood-sugar is formed, at least in carnivorous animals, exclusively from albuminous bodies. 6. The sugar content of the blood rapidly diminishes when the liver is excluded. This sugar is used up in all the living tissues.—*Pflügers Archiv, Bd. 34, S. 388.*

THE PREVENTION OF HYDROPHOBIA.—MM. Pasteur, Chamberland and Roux have made the following communication on the prophylaxis of rabies by inoculation with a modified virus. They find (1) that the virus transferred from the dog to the ape, and cultivated by propagation through several members of the latter order, becomes progressively feebler after each inoculation. After a certain period of such cultivation, if it be hypodermically administered to dogs, guinea-pigs or rabbits, or even by intracra-

nial injection (the most deadly method), death does not result, but the animal acquires an immunity from hydrophobia. (2) If, on the other hand, the poison of rabies be cultivated in successive rabbits or guinea-pigs only, its potency is intensified, and after a time is so great that a fatal issue invariably follows its inoculation. The poison as found in the dog is intermediate in strength between that of the two methods of cultivation just mentioned. Thus by careful selection of the medium and the stage of cultivation, it is possible to accumulate a store of attenuated virus which can be relied on to communicate a modified rabies whose inoculation shall be protective against its severer forms, as that of vaccinia is against variola. There is also good reason to believe, though the actual experiment is postponed, that, as with vaccinia, the modified poison hypodermically engrafted immediately after the bite of a rabid animal, will forestall, by the speed of its development, the symptoms due to the bite. No experiments have as yet been made on the human subject. (*Progrès Médical*, May, 1884). The experiments which M. Pasteur is reported thus far to have made are said to be an unbroken success. Fifty-seven dogs have been the subjects of investigation. Of these, nineteen were rabid, and by these, thirty-eight healthy animals were bitten under uniform conditions. Of the thirty-eight, one-half the number had been previously inoculated or "vaccinated" with attenuated virus, the other half had not. The latter, without a single exception, died with unequivocal signs of rabies, whereas the nineteen others remain as well as ever. They will be watched for a year by veterinary surgeons to see whether the inoculation holds good permanently or only temporarily. If rabies be not spontaneous in its origin, and if the experiments of Pasteur all turn out successful, there seems no reason why canine madness should not be extirpated from our midst.—*Lancet, July 12, 1884.*

PSYCHOLOGY.

CLEVENGER ON THE EVOLUTION OF MIND AND BODY OF MAN AND ANIMALS.[1]—We have here a work, scientific and speculative, on several of the live questions of the day. The author is an evolutionist physical and metaphysical. More than this, he is a mechanical evolutionist, and endeavors throughout the book to prove the origin of structures through use and effort, and their loss by disuse. The especial object of the discussion is to demonstrate the origin of mind and its various departments by the action of its material basis. From this process he does not exclude consciousness as a necessary factor. When he comes to the origin of consciousness, the author writes as follows (p. 18): "The amœba's functions are simple, but nevertheless the same as

[1] Comparative Physiology and Psychology, by S. V. Clevenger, M.D., Chicago, Jansen McClurg & Co., 1885, pp. 247.

our own. Forthwith we must assign it a desire for food, which desire is the chemical affinity of atoms; then the Amœba hungers." The origin of movements under the stimulus of pain and pleasure is next followed out. The reproductive instinct is referred to as a modified form of hunger. There is also a theory of the origin of the brain; and another as to the origin of the differentiation between the motor and sensory nerves and their functions. The work is a brilliant one, and is studded with epigrammatic sentences, some of which have points which will be felt, but whether pleasurably or painfully will depend on the opinions of the reader. For instance; "Sociologically the money-grubber devours the services of men of brains, and the issue of the business is the development of faculties and facilities for mercantile improvement both in the sordid and mental aspects." Again: "A Chicago writer dislikes to credit any one in Arkansas with a good thought. A New York or Boston man cannot conceive of Chicago originating anything, and across the sea the general run of scientists avoid any mention of America or its workers if possible. Darwin was a notable exception to this rule, for he was above pettiness." The author has ransacked the literature of his subject, and has made a most interesting book.

The writer undervalues metaphysics, which he calls "lunar politics." Hence his identification of consciousness with chemical affinity (see above on hunger). This is a fundamental point in the science of mind in the large sense, though it may not greatly affect theories of the evolution of the human mind out of consciousness with the aid of memory and molar motion. We have already explained in this journal (1884, p. 973, on Catagenesis) and elsewhere the opposite doctrine, that consciousness is not a form of energy, but that although inseparably bound to matter and energy, it is coëqual with them. Some reasons for this view may be restated as follows:

When a form of energy is developed (as heat, light, etc.), which was not present before, we know, in accordance with the law of the conservation of energy, that the energy was already present in some other form. We thus get something out of something. We cannot hold the same view when consciousness appears where it had not been before. It is like the attempt to add beans and potatoes to get apples, etc.; in a word it is an attempt to get something out of nothing. To look upon it as a *product* of the metamorphosis of energy is like regarding a man as the product of the door which is opened in order to admit him to sight. None but a savage could entertain such an opinion. In view of the nature of the case, as well as of the truths of Kinetogenesis, so well presented by Dr. Clevenger, it is much more logical to believe that the consciousness is derived from an outside source, and is communicated to matter which is in a proper energetic state. The difficulties in the way of this view are largely if not

entirely removed by the well-known facts of *discontinuous consciousness.* There is a form of brain malady in which persons whose consciousness is clearly continuous to outside observers, lead two or more distinct conscious lives, the one of which knows nothing about the other. This is caused by the *abolition of the memory* of a part of the conscious existence. Now it is far more probable than not, that in a transfer of consciousness from one physical basis to another, the molecular structure which is the condition of memory is lost in whole or in part. Hence the absence of prenatal memory. If the mind ever learns of its forgotten life it must be by a process of exploration and unraveling of records. Such a research would be a palæontology of mind, and its materials are doubtless as abundant in the universe as are the records of the physical organisms which we now excavate from the rocks.—*E. D. C.*

A Horse's Memory.—Our sagacious little family horse—"Joe"—was kept at our place a few weeks one winter several years since, and then taken back to his owner, thirty-five miles away. Twenty-one months later I purchased him. He was led to town by the stage-driver, where I received him a mile and a half from my farm. I saddled and mounted him and told him to "go," leaving him, however, to take his own course, with a view to seeing whether he remembered the way home. Several turns were to be made in the village streets in getting out of town, but Joe made every one as correctly as he would to-day, after having traveled the same little journey daily for years. We finally crossed a bridge over Boone river, at the west end of which a gate opens into a grove, the house being forty or fifty rods off to the north. Joe stopped at the gate of his own accord, waiting for me to dismount and open it. He seemed to know every rod of the way, both to the barn and the stable, though he had been away about a year and nine months. He was a little disconcerted, however, upon going into the stable, appearing lost for a moment, but the cause of his embarrassment was sufficiently apparent from the fact that the stalls had been changed to the opposite side. It was perfectly clear, however, that he had not forgotten a single detail of his daily life during his first brief sojourn with us.—*Charles Aldrich, Webster City, Iowa, Nov. 21, 1884.*

Training Elephants.—African elephants, said Forepaugh to a reporter, are more intelligent, imitative and cunning than the Asiatic. In training elephants the best method is to win them over by petting and feeding them with something nice. I always have a cake or some delicacy to give one of them when I take him out for practice, consequently the beast is always glad to see me, and is more attentive and docile than he otherwise would be. Elephants never forget anything—they recollect "their stage business" and "situation," and do not vary an inch one evening

from another in taking their positions. It requires about five months to train an elephant. We practice from 6 o'clock in the morning until 6 o'clock in the evening. They are drilled singly, and then in squads, and then taught their various "specialty" acts and tricks. Elephants are more imitative than any other animal perhaps, and are very cunning. While practicing they are looking out for an opportunity to "cut up," and will reach back and kick the trainer, and then look as innocent as a truant school-boy. They seem almost human enough to talk. The importation of elephants has increased tenfold within the past decade. Ten years ago very few circuses had more than three or four elephants, and one was the usual number; now, no circus is complete without fifteen or twenty.—*Exchange.*

THE CHIMPANZEE IN CONFINEMENT.—At the Zoölogical Gardens, Philadelphia, are two interesting individuals of this species. Although they are comparatively young, perhaps not older than six years, yet they have an extremely antiquated appearance. I heard a countryman say to a bystander that he "guessed they were 70 years old, easy." One of them has such a great fondness for an old blanket that he carries or drags it with him wherever he goes. Even if he desires to climb to the extreme top of his cage, the blanket must go along, although it greatly retards his progress. He knows its use, but does not always use it judiciously. Thus, on an oppressively hot day in July, I have seen him reclining for twenty minutes or more, entirely enveloped in the blanket, with the exception of his face, looking at the spectators with a comical and pouting expression. I saw one, when teased and disappointed by its keeper, throw itself upon the floor, and roll and scream vehemently, very like a naughty child in a tantrum. A board shelf was placed across their cage for them to climb upon. This they soon found could be used as a spring-board, and nothing seems to give them more pleasure than, when there is a good audience, to steal gently to the center of the board, grasp it tightly with all fours, and spring violently up and down, causing the board with themselves to vibrate rapidly, and producing at the same time a loud, jarring noise. They then seem to greatly enjoy the startled and amused looks of the spectators. Perhaps one of their most human actions is languidly to recline, and holding a straw in one hand, listlessly to chew at its tip, while the eyes are rolled vacantly around. It may be that they are then building "castles in Spain."
—*C. F. Seiss, in Scientific American.*

ANTHROPOLOGY.[1]

THE PRECURSOR OF MAN.—At the meeting of the French Association at Rouen, last year, the section of anthropology made an excursion to Thenay, near Blois, to study the question of Tertiary man. The digging was performed under the direction of

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

MM. d'Ault-Dumesnil and F. Daleau. In a small volume, prepared by le Marquis de Nadaillac, and distributed among the members, entitled: "Notice sur Blois et les environs;" a chapter of fourteen pages is devoted to the silex of Thenay. In greeting the congress M. le Senateur Dufay discarded the term "Tertiary man," and spoke without apology of the *Anthropopithecus*, a name invented by M. G. de Mortillet. The succession of beds, as revealed by Abbé Bourgeois, is as follows:

A. Vegetable mold.....0.60m
B. Shell marl, mass of marine fossils.....0.40
C. Beds of fresh-water calcareous deposits, with Pholas excavations in the upper portion.....0.32
D. Fresh-water white marls, foliated, flint rare 0.75
E. Bed of fresh-water limestone.....0.25
F. Marls as in D, silex rare 1.15
H. Bed of clay, with calcareous nodules and bones of Acerotherium.....0.24
I. Marls as in D, silex rare 0.92
K. Foliated marls, darker and containing numerous flints broken and retouched 0.60

The flints brought to light reveal not only the effect of working, but the influence of fire. This past phenomenon M. G. de Mortillet discusses at length, in l'Homme, 1884, p. 550. Now with these facts clearly stated the next duty is to study them dispassionately. The *Anthropopithecus* must be fairly treated. On the one hand there is nothing sacred about him, and he may have to be knocked on the head; on the other hand, he is not, *per se*, as a rival of "Tertiary man," to be hustled off the wharf.

INTERNATIONAL GEOGRAPHICAL EXPOSITION.—At the seventh National Congress of French Geographical Societies to be held in Toulouse in next August, will be organized an international exposition, of which the fifth section relates to anthropology. M. E. Cartailhac will have charge of this section, of which the following is an outline:

I. *Anthropology.*— Crania, skeletons, tissues; figures and busts, especially with reference to races.
II. *Demography.*—Statistical studies of peoples; graphic methods, charts, copies of works.
III. *Prehistory* —Human remains, relics; charts, books, objects, prints, *et similia.*
IV. *Ethnology.*
V. *Glossology.*
VI. *Instrumentalities*, of research and instruction.

Considerable space has been given to these programmes because the time has come to give to our science a more restricted definition in the use of terms and the classification of objects. In other words, we ought to know what terms to apply and what arrangements to make of our specimens, to exhibit and to describe them. The NATURALIST will open its anthropological department for the discussion of these two ideas, the meaning of words and the best methods of classifying. The last point will include the number and relative importance of classific concepts as well as the method of separating and studying materials.

TURNER'S SAMOA.—Readers of books often wish that authors would so concentrate their writing as to tell just what we want to know and not one word more. This is unreasonable; but, on the other hand, most authors write a great deal that is never quoted by anybody. Twenty-three years ago George Turner published his celebrated work, Nineteen Years in Polynesia, in which he mingled his experiences as a missionary with accounts of the natives that our greatest anthropologists were never tired of quoting. In the volume now before us the ethnographic matter has been extracted, much new matter has been added, and the whole has been so arranged and indexed as to constitute a text book on Polynesia of the highest order. Dr. E. B. Tylor endorses the work in an appreciative preface. The first two chapters relate to the Samoan group and the traditions of their origin and names; the third, fourth and fifth to the religion and the gods of the natives. The rest of the chapters take up the general subject in the following order. The people: infancy, childhood and adult years; food, cooking, liquors; clothing; amusements; mortality, longevity, diseases; death and burial; houses; canoes; articles of manufacture; government and laws; wars; the heavens and heavenly bodies; origin of fire and other stories; names of the islands illustrating migration; political divisions; ethnological notes on Bowditch, Humphreys, Mitchell, Ellice, Tracey, De Peyster, Spieden, Hudson, St. Augustine, Rotch, Hurd, Gilbert, Francis, Netherland, Savage, New Hebrides, Loyalty, New Caledonia and New Guinea islands. One hundred and thirty words are given in the following fifty-nine languages: Marquesas, Tahiti, Hawaii, Raratonga, Manahiki, Samoa, Niué, Fakafo, Tonga, Bau, Rotuma, New Zealand, Aneiteum, Niua, Tanna, Eromanga, Vaté, Nengone, Lifu, New Caledonia, Ebon, Moreton bay, Malayan, Javanese, Bouton, Salayer, Menado, Bolanghitano, Sanguir, Salibabo, Sulu islands, Cajeli, Mayapo, Massaratty, Amblaw, Tidore, Gani, Galela, Liang, Morella, Batumerah, Lariko, Saparua, Awaiya, Caimarian, Teluti, Ahtiago and Tobo, Ahtiago, Gah, Wahai, Matabello, Teor, Mysot, Baju, Dorey, Pt. Moresby, Madagascar.

Whatever other book the ethnographer may have to do without, he cannot afford to deprive himself of this concentrated treatise.

SNAKE DANCE OF THE MOQUIS.—Three years ago, that prince of collectors, Col. James Stevenson, sent to the National Museum a large collection of rudely-carved and painted dolls, wands, head-gear, blankets, rattles and other paraphernalia relating to the Moki sacred dances. Following him, Mr. Cushing, who understands very well the purport of these objects, mounts them for the great exposition at New Orleans; and to cap the climax, Captain John G. Bourke, U.S.A., writes a charming book describing the manners and customs of the Moki, their seven

communal towns perched upon the mesas of Northeastern Arizona, and relates with great minuteness his attendance upon the snake dance, a rite which seemed revolting even to the enthusiastic narrator. Everybody should read the book. We do not know which to praise the most, the author for shaking off the lethargy of camp life and gathering the material, the happy, often frolicksome style in which the work is written, or the beautiful illustrations which throw so much light upon the text. We have only space here to say that in the month of August every year the Moki celebrate a snake dance. Eight days before the dance the young men go north one day, west one day, south one day, east one day, and the other four days they roam all over the country, if necessary, to catch the snakes, using all kinds. These reptiles are placed in an estufa until wanted, kept in order by certain old men who have no other weapon except a small stick, at the end of which are two eagle feathers. The snakes are afraid of the birds of prey, and seem to have a wholesome dread even of their feathers. After the most elaborate preparation, witnessed by Captain Bourke, the dancers march through the principal streets, certain of them carrying each a squirming snake in his mouth, the animal being kept in order by a companion using the eagle-quill teaser. The closing chapters of Captain Bourke's volume are devoted to the daily life and customs of the seven Moki towns.

Why Tropical Man is Black.—Dr. Nathaniel Alcock contributes to *Nature* a very interesting paper in which he argues that light and actinism have coöperated with heat in the coloring of the skin. If man could live by heat alone, in the tropics the black man would be fittest, because he would be the hottest. But light has also played such an important part that those in whom a portion of the rays of the glaring sun are blocked at the surface are best adapted for survival beneath its vertical beams. The waves of light and heat follow each other at similar rates through the luminiferous ether. When light or heat impinges on man its waves select those atoms whose periods of vibration synchronize with their own period of recurrence, and to such atoms deliver up their motion. It is thus that light and radiant heat are absorbed. Heat waves thus notify their existence along the surface fiber to the central nerve cell, and so enable the animal to avoid their action, if excessive, or seek their increase if deficient. While heat waves are thus received and responded to, their fellow workers, the waves of light, are not inert.

Admitting that theoptic nerves are but nerves of the skin, whose molecules once could vibrate only with the large ultra-red waves of heat, it must be conceded that in the first instance all surface nerves must have felt the influence of that agent by which they are to be hereafter exalted. But a yet more wondrous lesson is to be learned from the steps which nature takes for the

exaltation of a heat-responding nerve into one capable of vibrating in harmony with the shorter waves of light. In the *Euglena viridis* a colorless and transparent area of protoplasm lies in front of the pigment spot, and is the point most sensitive to light. Progressingupward we ever meet with the same arrangement, transparency immediately in front of the part to be exalted, and pigment immediately behind it.

Nature has made the most of her two factors by exposing the selected tissue to the continued impinging of waves of light, at the same time securing not only the transmission through it of the waves of heat, but their constant accumulation behind it, thereby causing the molecular constituents of the protoplasm to be thrown into the highest rates of vibration possible with the means at disposal.

Recognizing the effects of simultaneous light and heat when their influence is concentrated, by a local peculiarity, on a particular part, must it not be evident that in an individual unprotected by hair and unscreened by clothes, living beneath the vertical rays of an equatorial sun, the action of these two forces playing through a transparent skin upon the nerve endings over the entire surface of the body, must be productive of intense, but at the same time disadvantageous nerve vibrations, and that presumably such individuals as were least subject thereto would he best adapted to the surroundings. Nature having learned in ages past that pigment placed behind a transparent nerve will exalt its vibrations to the highest pitch, now proceeds upon the converse reasoning, and placing the pigment in front of the endangered nerve reduces its vibrations by so much as the interrupted light would have excited, a quantity which, though apparently trifling, would, when multiplied by the whole area of the body surface, represent a total of nervous action that if continued would soon exhaust the individual and degrade the species.

Thus it is that man still retains in its full strength the color of skin which, while it aided him materially in his early escape from his enemies, is now continued because it has a more important office to fulfill in warding off the millions of vibrations a second which would otherwise be poured in an uninterrupted stream upon his exposed nervous systen.—*Nature, Aug. 21, '84.*

MICROSCOPY.[1]

Modern Methods of Microscopical Research.—Microscopical technique has made such rapid progress in the last few years that it has been found necessary to supplement our hand-books of methods through the publication of special journals and departments of journals which undertake to bring together the latest discoveries and improvements. A new and very important line of

[1] Edited by Dr. C. O. Whitman, Mus. Comparative Zoology, Cambridge, Mass.

work has thus been started, and this work is destined to grow rapidly in general importance and interest. It may be worth while to consider briefly the character and the urgency of such work, and to suggest how its aims can be promoted by those who are actively engaged in the various fields of microscopical research.

The microtome has come to occupy a place in the zoölogical laboratory second in importance only to the microscope itself. Many improvements in details and in accessories have followed the introduction of this instrument, and a whole series of methods has sprung up in connection with its use. In short, we have a new art which has been appropriately called *microtomy*.

The general favor with which the microtome has been received is the best evidence of its usefulness. There ought no longer to be any place for prejudice or indifference in regard to its merits. The use of the instrument is so simple and the methods connected with it so easily acquired that no naturalist can afford to work without it.

It is not enough to possess a microtome and to be master of its simpler uses; the working naturalist should have the best, or one of the best instruments in the market, and it is important that he should have the earliest information of any improvements attending its use.

Within the last four or five years the improvements and discoveries in microtomy have been both numerous and extremely important. Among these may be mentioned the ribbon method of cutting serial sections, discovered by Caldwell; the methods of fixing sections on the object-slide, discovered by Giesbrecht, Schällibaum and Mayer; the various section-smoothers, notably those invented by Mayer, Andres, Giesbrecht, Schulze and Decker; the use of collodion to prevent the crumbling of brittle sections, proposed by Mason; and the methods of reconstructing objects from serial sections employed by His and Born. A large number of new preservative and staining fluids have been described; and new methods of killing, hardening, preserving, staining and imbedding have been recommended. The rapid development of methods is at once the result and one of the chief causes of the increasing activity in every field of biological research. The improvement of methods leads to the re-investigation of old subjects, and at the same time prepares the way for attacking new problems. The investigator who neglects to keep himself informed of the progress in methods of study, throws away his opportunities, and has the vexatious mortification of seeing himself outdone and his work superseded by that of more skillful hands.

So much depends on successful methods of preparing objects for investigation, that naturalists are now expected to state precisely how their results have been obtained. But the methods

are usually given with the investigations themselves, and are therefore scattered about in different journals and isolated publications; hence arises the necessity for some sort of repertory in which the stray accounts and straggling items may be gathered and summarized. The department of microscopy will make this work its special concern. The necessity for immediate information makes it impossible to avoid a more or less chaotic presentation of subjects, and reviews of progress in special directions will therefore be in order from time to time.

There is another feature of the work proposed in this department to which we wish to invite particular attention. Experience has shown that each different object requires a special mode of treatment, and that the same object must be treated differently according to the nature of the problem in hand. For example, the course of preparation which has given satisfactory results in the study of the development of the ova of a certain species, may prove quite inadequate when applied to a different though closely allied species. And it has been found that different stages in the development of the same ovum often require different modes of preservation. The investigator cannot, therefore, blindly adopt the methods employed by others, but must, in by far the greater number of cases, determine by experiment the method to be pursued. But such experiments demand a general knowledge of methods, and, above all, a knowledge of the special applications of methods in cognate subjects. It is in the adaptation of methods to special subjects that the skill of the investigator is shown. Our information of the methods employed in specific cases should be as extended as possible. To meet this need entire courses of methods that have led to successful results in typical cases will continue to find a place in this department.

Such then are the aims of "microscopy." If those who take an active interest in the cultivation of microscopical methods desire to further these aims, they can do so, and at the same time confer a favor, by communicating to the editor any information respecting methods which they have found useful, or by sending published accounts of important methods for review in these pages.

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SCIENTIFIC NEWS.

— The winter session of the Teachers' School of Science connected with the Boston Society of Natural History commenced in October with a lecture on sponges, by Professor Alpheus Hyatt, who will conduct a course of ten lessons upon the structure of animals. The plan pursued by Professor Hyatt has special reference to the teaching of methods of observation. On. Jan. 3d will be commenced a supplementary course of ten practical laboratory

lessons in elementary mineralogy, to be given in the laboratory of the institute by Professor W. O. Crosby and Mrs. Ellen H. Richards. The class is limited to fifty teachers, one to be nominated by each of the masters of the Boston grammar schools.

— The Biological School of the University of Pennsylvania was opened on Nov. 3d. Professor Harrison Allen delivered the opening address. He outlined the objects of the school in a masterly manner, pointing out that original research is its leading aim. It is to be hoped that Professor Allen's views as to its conduct will be carried into effect, otherwise it will become a school of instruction only, and as such an unnecessary addition to the general university course. In order to do this its chairs must be filled by original investigators.

— *Limulus polyphemus*, the horse-shoe or horse-foot crab, as it is called in New Jersey, in whose flat sandy bogs it lives in immense numbers, is becoming useful as food for fishes. Enormous numbers are fed to eels, which greedily devour them. In one pond they were said to consume seven hundred and fifty horse-feet in three days. It would seem impossible to furnish so many, but the number does not begin to detail the extent of the catch. Millions of them are annually fed to swine and poultry, and some men make a business of catching them. On June 15, after a storm, Captain Downs, with a trap of his own invention, caught one thousand "feet," and between the 15th of July and April his aggregate catch was nineteen thousand.

— The St. Louis Academy of Science and the Missouri Historical Society according to the Kansas City *Review of Science*, have finally gained the property which has been so long in litigation and will probably at once erect a building suitable for the purposes of both bodies. The property was given by the late James H. Lucas, a number of years ago, but the delivery was refused by his heirs on account of delay in complying with the terms of the grantor.

— James Macfarlane, Towanda, Pa., is preparing a second and much improved edition of his Geological Railway Guide, and wishes persons who have used the book to send him corrections and additions. If it will be a saving of labor, they may send him their copies of the book containing such notes by mail, which he will return refunding the postage.

— The French Association met at Blois, as announced on the 3d inst. One of the most interesting subjects of the sitting was the examination of the Thenay geological strata, where Abbé Bourgeois thinks he has discovered Tertiary man. The principal French geologists arrived in Blois for the excursions, but there were very few foreigners.

—Among the faculty of Bryn Mawr College for ladies, to be opened next year near Philadelphia, we notice the name of

Dr. Edmund B. Wilson, late lecturer on biology in Williams College and author of zoölogical essays of sterling value. The standard of science-teaching in our American colleges is steadily rising.

— The *Naturæ Novitates*, published during the last six years every fortnight by R. Friedländer & Sohn, at Berlin, is sold for a dollar a year, and proves a useful bibliographic list of current literature of all nations on natural history and the exact sciences, with brief news items, which we find of occasional use.

— The meeting of the German naturalists and physicians was opened September 18, at Magdeburg; over a thousand members were present. The association will meet next year at Strasburg, with Professors Kussmaul and De Bary as secretaries.

— Professor Dr. Arnold Foerster, the well known hymenopterist, died at Aachen, Aug. 13. He was a school-teacher, and we well remember his courteous greeting when we called on him twelve years ago.

— Alfred E. Brehm, the author of Illustrirtes Thierleben, and well known as a traveler, died in November last; he was born in 1829. Dr. L. Fitzinger, the well-known zoölogist of Vienna, died Sept. 22.

— We regret to notice that *Science Record*, of which two volumes have appeared, published by S. E. Cassino & Co., and edited by Mr. J. S. Kingsley, ceased to exist with the December number.

— The next meeting of the Society of Naturalists, E. U. S., was to be held at Washington, D. C., during the week following Christmas, 1884.

— The late Sir Erasmus Wilson's munificent bequest to the Royal College of Surgeons is expected to reach the sum of £200,000.

— On July 25, 1884, died in London George B. Sowerby, known as a conchologist and palæontologist. He continued the Thesaurus Conchyliorum begun by his father.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Nov. 29, 1884.—The following communications were presented: Mr. Sanderson Smith on the recent deep-sea explorations of the United States Fish Commission, with special reference to geological results; Mr. Leonard Stejneger exhibited specimens illustrating the shedding of the bill in auks; Dr. George Vasey on the grasses of the arid plains; Mr. Charles D. Walcott on the oldest known fauna on the American continent; Professor Lester F. Ward on the occurrence of the seventeen-year locust in Virginia in October, 1884.

NEW YORK ACADEMY OF SCIENCES, NOV. 10.—The following paper was read: Elephants, ancient and modern, with reference also to the extinction of the mammoth; and notes on the small elephants lately brought to this city from farther India (with lantern illustrations), by Professor H. L. Fairchild.

Dec. 1.—The paper of the evening was Iroquois customs and language, by Mrs. Erminnie A. Smith.

BOSTON SOCIETY OF NATURAL HISTORY, NOV. 5.—Mr. S. Garman exhibited a novel type of flounder; and Mr. John M. Batchelder spoke of the lamprey as a builder.

Dec. 3.—Mr. F. W. Putnam gave an account of the explorations of ancient earthworks in Ohio, made during the past season by Dr. Metz and himself for the Peabody Museum.

AMERICAN GEOGRAPHICAL SOCIETY, NOV. 10.—Lieutenant Shufeldt, U. S. Navy, delivered a lecture entitled, Madagaskara: the land of Sinbad, the sailor; a journey of exploration across the great African island (illustrated with twenty-five stereopticon views from original photographs taken by the lecturer).

APPALACHIAN MOUNTAIN CLUB, Boston, Nov. 12.—The reports of councillors was presented, and Mr. Samuel H. Scudder read a paper entitled, The Alpine Club of Williamstown, Mass.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, May 1.—No less than fifty distinct species of sponges from Florida were presented by Mr. Jos. Willcox. This gentleman remarked that the limestone of the peninsula is eroded into numberless caverns, and is full of sinkholes, yet when exposed it is hard and in some localities marble-like. He believed that sea-urchins cannot have protection in view when they cover themselves with sea-weed, as they are more conspicuous thus covered. The common *Busycon pyrum* of the coast always deposits its eggs below the sand, attaching the egg-cases to a shell at least eight inches below the surface. Two mollusks, *Fasciolaria tulipa* and *Melongina corona*, break holes in the shields of king-crabs and eat out the flesh. Saw-fishes are abundant in shallow water, and it was observed that when they were speared they would turn up the saw and pull it repeatedly across the handle of the spear, soon making a notch. The sand of the beach is siliceous, and is probably derived from the mainland of Georgia. Mr. Potts stated that he had received several fine fresh-water sponges from the St. John's river, near Palatka. One of these he believed to be a new Meyenia, for which he proposed the name *subdivisa*. Mr. Ford reported the finding of *Pholas cuneiformis* in a billet of wood at Anglesea.

May 8.—Dr. Leidy exhibited fragments of a tapeworm widely differing from the tapeworms usually found in man, and probably

belonging to *Tænia flavopunctata*, a species observed but once before, when it was described by Professor Weinland. It is probably more common than might be supposed; its small size (fifteen inches or so in length) may have caused it to pass unnoticed, or it may have been confounded with other species.

May 16.—Dr. McCook gave the details of the mode in which *Lycosa riparia* forms its egg-ball; the spider (one kept in captivity) made an excavation and covered it with a thin sheet of silk; on the wall of her cave she then spun a cushion of white plush about three-fourths of an inch in diameter; in about half an hour the egg-mass was deposited and covered over with a layer of silk similar to that of which the cushion was composed; soon after the cushion had disappeared, and the round ball was dangling from the end of the spider's abdomen in the usual manner; as the spider has not excavated since, her evident object was to secure seclusion. The same speaker called attention to the discovery, by Mr. Alan Gentry, of spiders in full health and activity beneath the surface of the ice of a frozen pond; when found they were passing from point to point on lines stretched between water plants at a distance of eight or ten feet from the bank. Dr. Leidy exhibited specimens of *Pentastomum proboscidium* from the lungs of a Florida rattlesnake. Mr. Potts announced the discovery of great numbers of Cristatella in Harvey's lake, near Wilkesbarre. Specimens six inches long were found. In traveling they did not follow the sinuous course usual in the genus. The colonies have a persistent non-polypiferous appendage. As a provisional name he proposed *Cristatella lacustris*.

May 22.—Mr. Willcox stated that shell-mounds abound on the west coast of Florida. A portion of the town of Cedar Keys is built on such a mound. Human bones, stone implements and fragments of pottery are frequently found among the shells. On St. John's island, at the mouth of the Cheeshowiska river, may be seen a former place of manufacture of stone implements. Professor Heilprin announced that in addition to the foraminiferous genera previously described (Orbitoides, Nummulites, Operculina, Heterosteginæ, Biloculina, Quinqueloculina) he had found Spheroidina in the rock-masses from Florida. He believed that none of the genera save Orbitoides had before been found in America. He had found a second species of Nummulites, also one or two additional forms of Orbitoides, one of which (*O. ephippium*) proves beyond doubt the Oligocene age of the deposits. Mr. Potts stated that a correspondent in Jamaica had failed to find a single fresh-water sponge. He said that in obstructed water pipes he could find no traces of sponge, but only clay with iron impregnation. The skeleton spicules of *Meyenia leidyi* undergoes degeneration in the presence of iron.

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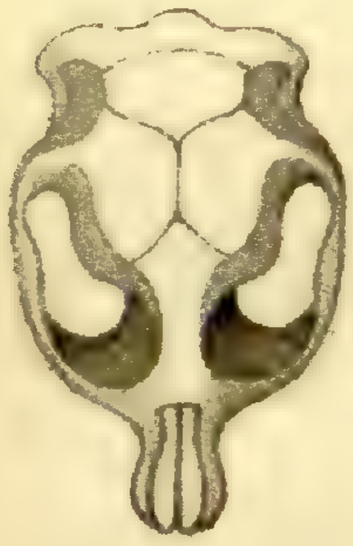

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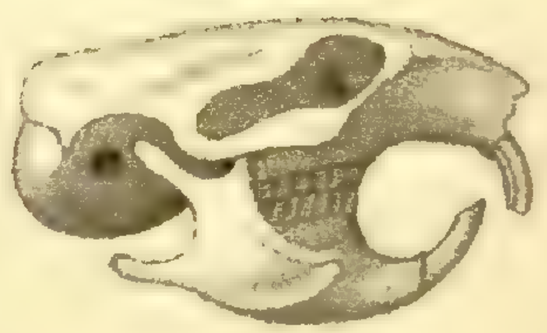

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T. Sinclair & Son, 12th Phila

SYNAPTOMYS COOPERI.

ERRATUM.

FEBRUARY NATURALIST.

Page 147, second line from bottom, omit "Batrachia."

THE

AMERICAN NATURALIST.

VOL. XIX.—*FEBRUARY*, 1885.—No. 2.

THE HABITS OF SOME ARVICOLINÆ.[1]

BY EDGAR R. QUICK AND A. W. BUTLER.

FOUR species of Arvicolinæ have been found in Southeastern Indiana, and it is to certain observations of the habits of these that your attention is called. The species referred to are *Synaptomys cooperi* Bd., *Arvicola pinetorum* LeC., *Arvicola riparius* LeC., and *Arvicola austerus* Ord. The latter is the rarest species, and *A. riparius* is by far the most common.

The credit of the discovery of Cooper's field mouse in Indiana belongs to that pioneer of Western naturalists, Dr. Rufus Haymond, who, in 1866, sent an alcoholic specimen of this mouse from Brookville to the Smithsonian Institution. Dr. Haymond says of this specimen: "I think it was in June, 1866, that I discovered this mouse about a mile north of Brookville. I thought it a common meadow mouse (*A. riparius*); when caught I put it into an old leather purse in which I had previously confined a small shrew. When I reached home I found the shrew had killed the mouse; the little murderer soon fell a victim to the law of blood revenge, and was packed with its victim in a jar and sent to the Smithsonian Institution." This mouse is numbered 9963 in the Smithsonian collection.

No other specimen was taken in Indiana for several years. In 1879 one of the writers took the second specimen found in this State, about three miles below Brookville and four miles from where the first one was taken thirteen years before. Specimen after specimen followed this one, all being taken from the same locality.

From the most reliable information obtainable, we conclude

[1] Read before the section of biology A. A. A. S. at Philadelphia, Sept., 1884.

that less than fifty specimens of this little mammal have ever been taken, of which number more than half have been secured by the writers from this same locality.

This mouse is found on hillsides in high, dry, blue grass pastures, where flat stones are irregularly scattered over the surface; it especially prefers what are known as "woods pastures," containing little or no undergrowth.

The locality whence Dr. Haymond obtained his specimen is a hillside pasture field, with no trees, sloping towards the east. The greater part of the other specimens have been taken from a steep rocky hill sparsely covered with timber, known as "Brown's hill."

Cooper's field mouse has been found breeding from February to December. It has never been known, by the authors, to bring forth more than four young at a time. In all suckling females which have been brought to our attention the mammæ have apparently been but four, one pair pectoral and one pair inguinal. Dr. Coues says (Monographs of N. A. Rodentia): "In No. 9963 (Dr. Haymond's specimen) apparently a nursing female, we find two pairs of pectoral mammæ and one pair of inguinal mammæ, without being able to make out any intervening ventral ones. It is probable, however, that the species possesses a ventral pair, making eight teats in all."

In this matter, from the light we now have upon the subject, we are not able to coincide with Dr. Coues in his views.

In young specimens the hair appears finer, shorter and more glossy than in more aged examples. As a rule the specimens just reaching maturity are darkest, but one old female shows a very dark reddish-brown back, and is dark ash below. If there is any difference in sexual coloration, the females are slightly the darker.

The nest of this species is always under cover, generally in a hollow log or stump, and is composed of fine grass. It is not so securely built as the nests of some of the other species of this family.

Cooper's mice live in winter chiefly upon the stems of blue grass and the more tender portions of the white clover. Stores of these foods may be found near their winter quarters. In November, 1883, a large quantity of the tuberous roots of the plant commonly called "wild artichoke" (*Helianthus doronicoides* Lam.)

were found in one of the store-houses of a colony of these mice.

These mice vary much in numbers in favorable localities in different years, but it is questionable whether this variation is from migration or irregular causes. In 1879 they were very common on Brown's hill, many of them frequenting the remains of an old stone mound. No other species were commonly met with in this locality at the same time. This year no examples of *S. cooperi* have been taken on the top of this hill, but a single specimen was found at the base of the hill. Since Dr. Haymond took his specimen north of Brookville no other example has been found in this direction from town, although sought for at different times.

Cooper's mouse is the most active representative of its family in this locality. It is most frequently found by turning over stones and logs, beneath which it remains concealed, especially in winter. Upon removing their covering, as the light reaches them, they are off like a flash for their subterranean paths, leaving the collector to mourn for a valuable specimen, a glimpse of which he caught as it fled before his hand could grasp the prize.

Another interesting representative of this family is the pine mouse (*Arvicola pinetorum* LeC.). This species has generally been considered rare in this locality, but in a two hours' hunt last February eleven specimens were taken by the writers. Several specimens have also been captured by a cat within a little more than a year.

Dr. Coues aptly says in his Latin description, "forma quasi-talpoidea;" the species strongly resembles the mole in form, especially in the size of its fore feet and in the strength of the forward part of its body, and also in its habits.

The runways of the pine mouse are nearly always under ground, sometimes an inch or more beneath the earth, the line of which may easily be traced by the upheaved earth.

The locality where the pine mice, to which reference has just been made, were taken, has long been a favorite place for the mice-catchers of the local society of natural history to find *Synaptomys cooperi*. On this particular occasion but a single specimen of this interesting species was taken, while almost a dozen examples of a species which had previously been regarded as rare were found in its accustomed haunts.

These examples were taken from the higher part of a steep, partially wooded hill. They apparently sought the west and south-west sides, where they were found beneath leaves, logs, stumps and stones. Upon the covering being suddenly removed they appear dazed, affording for an instant an opportunity to capture them; should the first attempt prove futile, they seek safety in the first available hiding place, but when frightened from here, hasten through their labyrinthic underground passages and are seldom seen again.

Of their breeding habits we have noted nothing. As a rule the pine mice winter in a last summer's nest, which is a round ball of blue grass blades, from four to six inches in diameter; the interior is composed of fine grass which is nicely bound together with longer blades. The nest is generally placed beneath a pile of leaves or an old stump. In winter collecting single specimens are generally observed occupying these old nests.

The pine mouse, in winter, lives upon the tender roots of young hickories, the young sprouts of the white clover (*Trifolium repens*), the fruit of the red haw (*Cratægus coccinea* L.) and the tuberous roots of the wild violet (*Viola cucullata* Ait.). The first of these he uses for luncheon while excavating his runways. It is never found stored in his burrows, but as his passages approach these roots they expand, laying bare a large portion of the root from which the bark is generally entirely removed. The other products we find buried, the latter in numerous deposits, some of which contain a gallon of tubers and extend eighteen inches below the surface of the ground. This latter article evidently forms the bulk of their winter food.

The common meadow mouse (*A. riparius*) is the most common mammal in Southeastern Indiana. It varies in numbers with the seasons.. Some years the fence rows of wheat and barley fields are traversed by a network of their runways. In autumn, after the frost has cut down the more tender parts of the weeds and grass, numbers of these little rodents may be seen darting here and there through their half-covered passages. In winter they are warm friends of the farmer who leaves his corn in the shock latest. After the early snows have fallen the corn shocks will be found thickly colonized by these little pests, who find here not only a comfortable residence, but also a well-filled granary from which to draw their winter's food. In spring, when the last snows

have disappeared, one will observe where the meadow mice have advanced their passages very near the public thoroughfare, while the neighboring pastures and commons show many traces of their highways. Their food in winter is the corn found in the thriftless farmer's shocks, together with the seeds of a number of plants and the young blades of the blue grass. Their large round nests are also constructed of the blades of this and kindred grasses. They are built much after the manner of musk-rat houses, a miniature of which they closely resemble.

The single opening is below, where it connects with the runways of the animal. These nests are found in almost every conceivable place : in thickets and brier patches among the rank grass which grows there, in swampy places upon a tussock of grass, in a log or fence corner, under a pile of rubbish and very many on the open ground, especially in clover meadows, where the mice may prey upon the nests of the humble-bee.

The meadow mice breed from February to December. A succession of favorable or unfavorable circumstances, as the case may be, causes either an abundance or scarcity of specimens.

This mouse has an ingenious and patient method of securing the head from a standing stalk of grain. Selecting a stalk which gives promise of a large well filled head, the mouse cuts it off as high up as it can reach ; owing to the proximity of the surrounding grain the stem will not fall, the butt end drops to the ground and another cut is made about four inches up the stalk ; the process of cutting off sections of this length is repeated until the grain is within reach. Here, after a square meal, the mouse leaves a collection of straws about four inches long together with a shattered head of grain to puzzle the farmer.

Arvicola austerus, called by some authorities "prairie meadow mouse," is the rarest of all our mice here. We think Dr. Langdon very properly calls this species the "wood mouse," on account of its attachment for the more open woodland or the grassy fields or newly cleared land adjoining such. All the specimens taken here have been captured by a cat, hence we are unacquainted with its habits.

Owing to the fact that all of these species live in summer surrounded by luxuriant vegetation, much less is known of their summer habits than of their life in winter.

The species with which we are best acquainted occur at times

in great numbers, while other years they are very scarce. During the years 1878 and 1879 *Arvicola riparius* was very common and could be found in every locality, but in 1880 most of them disappeared, and for a long time they were very scarce. They have slowly increased in numbers and are now as numerous, perhaps, as ever. Whether these strange reoccurrences are the result of migrations or disease we are, from the present state of our knowledge, unable to determine.

Mice have their enemies, as do most other animals. They are caught in large numbers by the smaller hawks (*Tinnunculus sparverius* Vieill, *Accipiter cooperi* Bp., and *Accipiter fuscus* Bp.), owls (*Scops asio* Bp., and *Asio accipitrinus* Newton); cats and dogs catch them as opportunity affords. Many also are killed by their curious little enemies, the shrews.

In habits no two of the species named approach each other very nearly except in general characteristics. They all appear to be gregarious, living as a rule in colonies. The pine mouse burrows deepest, and makes the most lengthy runways. The passages made by Cooper's field mouse are never of much length, but are very sinuous and intricate. In food each species appears to partake of some particular kind or kinds found near the locality it frequents. Except in case of the pine mouse and Cooper's mouse the localities occupied by each species do not appear to overlap, each frequents a peculiar kind of region wherein it plays its part in the economy of nature.

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ON A PARASITIC COPEPOD OF THE CLAM.

BY PROFESSOR R. RAMSAY WRIGHT.

SINCE the researches of Dana, published between thirty and forty years ago, comparatively little attention has been given to the Copepoda in America. So much is this the case that Gerstæcker in his account of the geographical distribution of the order,[1] mentions only sixteen species as inhabiting the fresh waters and coast region of North America, the described forms being all fish parasites. Of late, however, important contributions to the knowledge of the fresh-water, free-living forms have appeared in this journal,[2] and new parasitic species have been

[1] Bronn's Thierreich, Vol. v, c. 1876, p. 799.

[2] S. A. Forbes. Entomostraca of Lake Michigan, Vol. XVI.
C. L. Herrick. Heterogenetic development in Diaptomus, Vol. XVII.

added by Kellicott[1] and myself[2] to the list of those already described.

That much remains to be done in this direction may be gathered from the common occurrence in the gill-tubes of the ordinary long clam (*Mya arenaria*) of an interesting form, so large as to occasion surprise that it has hitherto escaped notice.

At the recent meeting of the Am. Assoc. for the Advancement of Science in Philadelphia, I proposed the generic name Myicola for the copepod in question, and shall describe the species as *M. metisiensis*, from the village of Little Metis, on the Gulf of St. Lawrence, where the specimens were taken.

The order Copepoda affords most interesting material for the study of various grades of parasitism. At one end of the series are the completely free forms, at the other the completely parasitic, in the adults of which it is often impossible to recognize any resemblance to the copepod type. But no important gap exists in the whole series. Even among those with well-developed jaws (Gnathostomata of Thorell) the Notodelphyidæ only occur as commensals in the branchial sacs of tunicates, while before we reach the completely parasitic forms, where the mouth is converted into a sucking tube (Siphonostomata), we find a large number of forms (the Poecilostomata of Thorell), some free and some semiparasitic, where the parts of the mouth are evidently formed for piercing soft tissues and thus obtaining fluid nourishment.

To the last section belong the Corycæidæ, Sapphirinidæ, Lichomolgidæ, Ergasilidæ, to which groups some authors accord family rank, while others are disposed to regard them as constituting a single family (Corycæidæ). It may be stated generally that while the fish parasites are chiefly Siphonostomata, and the ascidian commensals chiefly Notodelphyidæ, the copepod parasites of the other groups of the animal kingdom—Mollusca, Vermes, Echinodermata, Cœlenterata—are largely Poecilostomata. Thus members of this group have been found on the gills of cuttlefishes, on the delicate branchiæ of nudibranchs, in similar situations on marine annelids and holothuroids, and on the soft tissues of sea-pens and other cœlenterates.

The clam parasite also belongs to the same group, as do all

[1] Proc. Am. Soc. Micros., II and IV.

[2] Proc. Can. Inst., N. S. Vol. I, p. 243.

the Copepoda parasitic on Mollusca with the exception of the Penella larvæ found on the gills of cuttlefishes, the Artotrogus from the egg-sacs of Doris, and certain species of Splanchnotrophus, which bore into the skin of nudibranchiates.

Hitherto, so far as I have been able to determine, only three cases of Copepoda parasitic on lamellibranchiates have been recorded, viz., *Anthessius solecurti* Della Valle, on the external surface of *Solecurtus strigillatus*,[1] *Modiolicola insignis* Aurivilius, from the gills of *Modiola vulgaris* and *Mytilus edulis*,[2] and *Paclabius tumidus* Kossmann, from the pericardium of Tridacna (Philippines),[3] I have not had access to the description of the last-named form, which belongs to the Ergasilidæ, and, according to Aurivilius, shares the great development of the cephalothorax, the absence of appendages on the fifth segment and the long egg-sacs with the genus Ergasilus. The two other forms are closely related to Lichomolgus, and apparently still more closely allied to each other, for a comparison of the figures shows that their most divergent characteristics, the mouth parts and the fifth pair of thoracic appendages, do not present greater differences than are to be met with in the range of the genus Lichomolgus.[4] Further investigation will show whether it is desirable to retain them in separate genera.

It will appear from the following generic diagnosis of the clam parasite that it occupies a position intermediate between Lichomolgus and Ergasilus:

Myicola, n. g.—Cephalothorax of ♀ *oblong*, of ♂ pyriform, composed of six segments, the last of which is *reduced in size* and carries a pair of uniramous appendages. Abdomen as in Lichomolgus. Anterior antennæ of seven joints, posterior of four, robust, the *basal joint tumid*, the terminal one *converted into a single strong claw;* mandible with triangular base and *several setose lobes*. Maxilla as in Lichomolgus. First pair of maxillipedes *robust*, three-jointed, the *basal joints tumid*, the terminal one carrying two setose filaments. Second pair of maxillipedes *absent in* ♀, resembling those of Lichomolgus in ♂. Natatory feet as in Anthessius and Modiolicola.

This genus approaches Ergasilus in the conformation of the posterior antennæ and in the absence of the posterior maxilli-

[1] Della Valle. Sui coriceidi parassiti, e sull'anatomia del gen. Lichomolgus. Mitth. Zool. Stat. Neapel, II, 102.

[2] Aurivilius. Bidrag till Kännedomen om Krustaceer som lefva hos Mollusker och Tunicater, pp. 9 and 39, Sep: imp: from "Oef: Kongl: Vet-Ak: Förh.," Stockholm, 39 Arg.

[3] Kossmann. Zool. Ergebnisse, Leipz., 1877.

[4] cf. Brady. Brit. Copepoda, Vol. III.

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A Copepod Parasite of the Clam

pedes in the female. In the proportionate size of the thoracic segments, the position of the mouth and the conformation of the natatory feet, it approaches on the other hand the Lichomolgidæ, and especially those forms already found in Lamellibranchiata. The dimorphism of the cephalothorax, which is more striking than in any of the allied genera, is no doubt to be attributed to the cylindrical form of the water-tubes of the gills in which the females live.

If Lichomolgus and the Saphirinidæ be merged into the family Corycæidæ, as seems the most natural arrangement (cf. Claus, Lehrbuch der Zoologie, p. 554; and Brady, Zoölogy of the *Challenger* expedition, Vol. VIII, p. 109, *et seq.*), then the existence of the above described genus renders imperative the acceptance of Della Valle's proposal to include Ergasilus in the same family (*l. c.* p. 83). So extended, the family of the Corycæidæ would embrace some free and some semiparasitic forms, some parasites of pelagic animals, and a few whose females at least are constant parasites of Pisces, Mollusca, Vermes and Cœlenterata.

The following description of the species will, with the help of the figures, serve to elucidate its most important characteristics:

Myicola metisiensis, n. sp. ♀ 3^{mm} long, of which 1^{mm} belongs to the abdomen, inclusive of the furca. ♂ 1.75^{mm} and less. First four free thoracic segments of ♀ subequal, broader than long, the fifth smaller than the first abdominal segment and chiefly developed dorsally. Thoracic segments of ♂ gradually decreasing in breadth from before backwards. Double genital segments of ♀ abdomen nearly as long as remaining three segments. The posterior borders of the genital and two following abdominal segments of ♂ denticulated. Furcal segments as long as two last abdominal; setæ six, of which three are apical and one subapical. Rostrum shield-shaped; anterior antennæ as long as the head, the first, second and fifth joints the longest. Posterior antennæ directed downwards; shorter than the anterior. Labrum with lateral borders denticulated, and posterior border emarginate. Mandible with two setose lobes and two setose filaments. Maxilla with three setæ, of which the mesal is longest. Two basal joints of anterior maxillipede tumid, with two converging oblique patches of spines, the distal joint with a strong seta and terminating in two curved setose filaments of which the slenderer is attached like a palp. Posterior maxillipede of ♂ with basal joint denticulated. Basal joint of 1st pair of natatory feet with a row of strong spines on the ventral surface, decreasing in strength on the 2d and 3d pairs, and absent on 4th; 5th pair uniramous, with three joints, the two proximal of which carry each a distal seta, while the distal has two apical setæ and a subapical group of spines.

Egg-sacs two, cylindrical, $1^{mm} \times 0.5^{mm}$.

Spermatophores subpyriform, $0.2^{mm} \times 0.1^{mm}$.

♀ parasitic in the gill-tubes of *Mya arenaria*, at Little Metis, Quebec, Canada.

♂ free in the mantle-cavity of Mya.

I have not thought it necessary in the above diagnosis to give

an exhaustive account of the form of the appendages. If a second species of the genus should be found, diagnostic marks will be readily obtainable from the figures. The anatomy of the soft parts appeared to agree so completely with Della Valle's account of *Lichomolgus sarsii*, that I abstain from any description thereof.

There are two points of some interest which I have not referred to in the diagnosis. The mouth corresponds in position nearly to the notch of the labrum, and is situated between the points of the mandibles. Behind this point is a sort of vestibule bounded by the distal joints of the anterior maxillipedes, the dorsal wall of which is formed by the sternal surface between the basal joints of the mouth parts. A crescentic row of minute spines follows the curve of the maxillipedes, and two pointed chitinous processes project into the vestibule further back. These are connected with the chitinous framework surrounding the sockets of the mouth-parts. I have not had the opportunity of observing whether they play the part of teeth. They appear to me comparable to the lobes of the Metastoma (unterlippe) described by Claus[1] for Nereicola. A further agreement with that genus is the presence of a chitinous process which corresponds in position to the absent posterior maxillipede, and is no doubt a rudiment of that member.

I have met with no trace of the sixth pair of limbs described by Della Valle as projecting from the anterior half of the genital segment in Lichomolgus and do not hesitate to reckon all of the double genital segment to the abdomen.

The presence of female Myicolæ in the gill-tubes of a clam is readily detected by local swellings of the tube corresponding to the length of the parasites. With a needle they are readily freed, and swim about with considerable velocity considering that their legs have not been stretched since they were imprisoned in the gill. I am unable to say by what channel they reach their resting place. I have found some in the suprabranchial chambers, which would seem to indicate entry through the cloacal siphon, while I have found others, head upward, in the gill-tubes, which would appear to argue an entry, while still in the nauplius-stage, through the inhalant siphon and the water-pores of the gill-plates.

[1] Zeit : wiss : Zool., XXV, p. 342, pl. XXIII, fig. 21.

No considerable irritation appears to be set up by the presence of the parasite in the gill-tubes. The claws of the posterior antennæ and the setæ of the various appendages are often invested by a yellowish film undoubtedly derived from the blood of the host, but no greater exudation resulting in the formation of a cyst round the foreign body is to be observed, such as, *e. g.*, surrounds a Trematode sporocyst in a fresh-water mollusk. The granular contents of the intestine of the Copepod have a bluish-green tint, which is most readily noticed in the wider rectum, but I must leave undecided whether these are derived from the blood of the host.

The development of Myicola appears to resemble that of Lichomolgus closely. When I first collected the parasite in June, the eggs were in various stages of development; in August, when I was at liberty to study them, the females had lost their egg-sacs.

The difference in form of the male has been already referred to; the contrast in locomotion is just as striking; its movements are as rapid as those of a Cyclops. Further investigation must show how the females are impregnated. The presence of a well-developed posterior maxillipede in the male would appear to indicate that the female is clasped by these, while the spermatophores are attached to the genital orifice. If such is the case this must occur in the suprabranchial chamber before the female has become tightly wedged into a gill-tube.

Whether Myicola will turn out to be associated with *Mya arenaria* wherever the latter occurs, must be left for the future to decide. A search for Copepoda in other lamellibranchiates would probably yield other interesting forms, although they are hardly likely to be of such large size as the species at present described. I searched Mytilus and Mesodesma at Metis without detecting any such.

Some idea of the frequency of the copepod may be gathered from the circumstance that twenty-five females were obtained from fifteen clams out of forty examined.[1] Only one male was observed in this gathering, but their small size and comparatively free life favor their escaping notice. This observation, further, was made in August, when the females had, almost without ex-

[1] Three Malacobdellæ were found in the same.

ception, lost their egg-sacs. It is possible that the males would be more frequently met with in June or July.

EXPLANATION OF PLATE III.

(The drawings are all outlined by Zeiss camera lucida, and reduced by one-third.)

Fig. 1, Gundlach 1½″ × Zeiss Oc. II.
Figs. 2, 3, 8, Zeiss A × Zeiss Oc. II.
Figs. 4, 5, 6, 7, 10, Zeiss D × Oc. II.
Fig. 9, Zeiss Hom. Im. ⅛th × Oc. II.

FIG. 1.—*Myicola metisiensis* Ramsay Wright, ♀ from above.
" 2.—Head and part of 1st thoracic segment from below. *r*, rostrum, a^1, anterior, a^2, posterior antenna; *la*, labrum; *mn*, mandible; *mx*, maxilla; mxp^1, anterior maxillipede; *mt*, metastoma; *st*, the somewhat complicated sternal apparatus of the 1st pair of natatory feet.
" 3.—Posterior antenna, indicating the chitinous framework of the different joints.
" 4.—Maxilla.
" 5.—Anterior maxillipede.
" 6.—First pair of natatory feet.
" 7.—Fifth pair.
" 8.—♂ from above.
" 9.—Mandible of ♂.
" 10.—Posterior maxillipede of ♂.

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ON THE RUDIMENTARY HIND LIMB OF MEGAPTERA LONGIMANA.[1]

BY JOHN STRUTHERS, M.D.

THE author remarked that the interest attaching to the structure of whales depends largely on the fact that they present numerous rudimentary structures. Megaptera is extremely rare on British coasts. This one appeared in the Firth of Tay, and after sporting for some weeks in sight of the inhabitants of Dundee, was at last mortally wounded, and towed ashore dead, at Stonehaven, near Aberdeen, on January 8, 1884. It was a male, forty feet in length. The pectoral fin, the chief character of this species, was twelve feet in length. The parts containing the rudimentary hind limbs were removed and carefully examined in the anatomical rooms at Aberdeen. The presence of a rudimentary

[1] Abstract of a paper read before the biological section of the British Association for the Advancement of Science at Montreal, August, 1884.

thigh bone in this species had been discovered many years ago by the late Professor Reinhardt, of Copenhagen. The object of the author's inquiry was to ascertain the precise anatomical relations of this rudimentary structure, and if possible to throw some light on its meaning. For comparison the author exhibited to the section the rudimentary bony thigh bone, about the size of a hen's egg, which he had found in a great fin-whale, the razor back (*Balænoptera musculus*), in 1871, and a series of specimens of the more developed thigh bone and cartilaginous tibia, which he had dissected in the Greenland right whale (*Balæna mysticetus*), and his drawings of the ligaments and muscles connected with these parts in the right whale (*Jour. of Anat. and Phys.*, Jan. 7, 1881).

In this Megaptera he found the thigh bone to be entirely composed of cartilage, of a conical shape, the length five and a-half inches on the right side, four inches on the left. It was encased in a mass of fibrous tissue. This fibrous case was connected internally to its fellow of the opposite side; superficially and on the outside to the posterior pelvic muscular mass; and anteriorly, passing from the thigh bone itself, was a special band appearing like a fibrous prolongation of the bone. The thigh bone rested loosely on the pelvic bone without articular surface, but was bound loosely to the latter by a strong posterior ligament, and by a weaker ligament in the position of the hip joint in the right whale. A muscle about the size and shape of a forefinger, within a ligamentous tube, connected the thigh bone backwards to the great interpelvic ligament. This was the only muscular structure directly connected with the thigh bone. It would retract the bone. The fibrous connections of the bone were mainly adapted to resist outward and forward traction.

The author said, that looking to all these facts, the conclusion to which we must come is, that the thigh bone in Megaptera is a rudimentary structure, a vestige of a more complete limb possessed by some ancestral form from which the Megaptera is descended.

The skeleton of this Megaptera he hoped would be ready to be inspected by the members of the British Association at the meeting in Aberdeen in September, 1885.

ON FINGER MUSCLES IN MEGAPTERA LONGIMANA AND IN OTHER WHALES.[1]

BY JOHN STRUTHERS, M.D.

THE author's observation, showing the presence of finger muscles in Megaptera, was made on the individual beached at Stonehaven, near Aberdeen, on January 8, 1884, the description of the rudimentary hind limbs of which he had described at the meeting of the British Association at Montreal. The presence of muscles in the forearm of a whale had been first noticed by Flower (in *Balænoptera musculus*) in 1865, and described in the lesser fin-whale (*B. rostrata*) by Carte and Macalister in 1868, and by Perrin in 1870. The author had described these muscles in the *Journal of Anatomy and Physiology*, in *B. musculus*, in 1871; in *Hyperoödon bidens* in 1871 and 1873, and in the Greenland right whale, *Balæna mysticetis* in 1878. In *B. musculus* the muscles present were the flexor carpi ulnaris, flexor digitorum ulnaris, flexor digitorum radialis, and an extensor communis digitorum. *Hyperoödon bidens* is the first and as yet only toothed whale in which they have been found, except in the common porpoise, in which he found the flexor carpi ulnaris present. In Hyperoödon the extensor was divided into two, and much more developed than in *B. musculus*. In the Greenland right whale he found also an extensor carpi ulnaris and a flexor carpi radialis. In the narwhal, Beluga and common pilot whale (*Globicephalus melas*) he found these muscles to be present morphologically, but histologically represented by fibrous tissue and therefore reduced to the condition of ligaments.

Considering the enormous size of the pectoral fin in *Megaptera longimana*, he had been anxious to ascertain whether these finger muscles were present, and if so, whether they were more developed than in other finners, or more rudimentary. He found the same flexor muscles present as in *B. musculus*, but the two flexor muscles of the fingers, instead of being larger were together not half so large as in *B. musculus*. Also that the proportions of these two muscles were reversed, the ulnar flexor being about one-third the size of the radial flexor, instead of larger than it, as in *B. musculus*. The extensor aspect of the limb was not yet dissected, as he had had time just to examine the flexor aspect before

[1] Read before the American Association at Philadelphia, on Sept. 9.

leaving for Canada. The dissection of whales is no easy matter.

Here then we have these finger muscles in Megaptera not more developed in proportion to the size of the limb, but in a still more rudimentary condition. These facts, the author observed, could be reasonably explained only on the hypothesis of the descent of whales from some ancestor in which the fingers had more extensive movement.

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THE STRUCTURE AND DEVELOPMENT OF THE SUSPENSORY LIGAMENT OF THE FETLOCK IN THE HORSE, OX, &c.[1]

BY J. D. CUNNINGHAM, M.D.

THE author first alluded to the various examples which are found amongst the mammalian group of muscles becoming transformed into fibrous tissue and assuming the duties of ligaments. He had observed muscles thus metamorphosed in the foot of the pig, walrus, armadillo, elephant, &c., and Professor Struthers had, in a paper read before the British Association in Montreal, instanced a remarkable case in which a muscle in the rudimentary hind limb of a cetacean was completely converted into ligamentous tissue around its periphery whilst it remained muscular in its center.

The most remarkable examples of this muscle metamorphosis are to be found in the feet of the horse and ruminants. The suspensory ligament of the fetlock, as is well known, is muscular in its origin, and in every case its ancestry can be traced with the greatest clearness and precision. In the horse it is derived from the fibrous transformation of the two bellies of the flexor brevis medii, and if transverse sections are made of the ligament, the remains of these bellies may be observed in its midst in the form of two crescentic fleshy outlines placed side by side. Every here and there, however, the outlines are interrupted by patches of fat cells and degenerating muscular fibers. The suspensory ligament of the ox, sheep, &c., is derived from the fusion and fibrous transformation of the four fleshy bellies of the flexor brevis annularis and flexor brevis medii, and in transverse section these show as

[1] Abstract of a paper read before the biological section of the American Association for the Advancement of Science, in Philadelphia, 1884.

four circular outlines of muscular tissue, which are also broken in their continuity by fatty tissue and degenerating muscular fibers. The change, therefore, is effected by the fatty degeneration of the fleshy fibers of the muscles and the coincident increase of the connective tissue elements. It is an instance of a pathological process bringing about a morphological change.

The examination of these ligaments in their embryonic condition affords some interesting results. It shows that the amount of muscular tissue in their midst is proportionately greater than in the adult, and further, that so long as the embryo is *in utero* there is not the slightest tendency to fatty degeneration exhibited in this fleshy tissue. After birth, however, when the foot is called into play, and its requirements show a greater need in the suspensory ligament of fibrous than muscular tissue the change begins. The active change is thus confined entirely to the extra uterine life of the animal, but a condition is produced in the parent which affects the offspring. It is an admirable instance of the slow progress made by morphological changes and how processes of this nature are thrown back a stage in the embryo. Provided that the external circumstances which originally instituted the change remain unaltered, we may consider that there are two conditions at work, *conservative* in the embryo, *progressive* in the adult; but the latter has the advantage, inasmuch as it is aided by the influence of heredity. From this, therefore, we may argue that in the course of time the transformation of the suspensory ligament will become complete, and that ultimately not a trace of muscular tissue will appear in its midst. It is very evident, however, that the fleshy fibers will be longer of disappearing in the fœtus than in the adult.

——:o:——

THE WINOOSKI OR WAKEFIELD MARBLE OF VERMONT.

BY PROFESSOR GEO. H. PERKINS.

BEDS of primordial rock known as "the red sandrock" extend through Western Vermont from the northern limit of the State south into Shoreham where the formation disappears. Its breadth is nowhere very great, and it is chiefly confined to the immediate neighborhood of Lake Champlain. Here and there on the lake shore are bold headlands composed of this rock.

Most commonly it is a hard, dark red sandstone containing, besides a large percentage of silica, eight or nine per cent of potash, about the same of iron, and more or less of lime. The composition of the rock is not uniform, but differs greatly in different portions even of the same stratum.

The color, though chiefly dark red, is sometimes light red or even reddish-buff. Moreover the entire formation, which is about two thousand feet thick, includes limestones, dolomites, slates and shales, though the red sandrock is, in most places, by far the most conspicuous member of the formation, and forms the greater part of its thickness. Still, in some localities other beds make up a not inconsiderable portion of the whole, as the following section taken at Swanton by Sir William Logan, and given here with some modification, shows:

	Feet.
1. White and red dolomites (Winooski marble) with sandy layers;—some of the strata are mottled, rose red and white, and a few are brick red or Indian red. Some of the red beds contain *Conocephalites adamsi* and *C. vulcanus*	370
2. Gray argillaceous limestone, partially magnesian, holding a great abundance of *Palæophycus incipiens*	110
3. Buff sandy dolomite	40
4. Dark gray and bluish-black slate, partially magnesian, with thin bands of sandy dolomite. The slate contains fossils as *Obollela cingulata*, *Orthisina festinata*, *Camerella antiquata*, *Conocephalites teucer*, *Paradoxides thompsoni*, *P. vermontana*	130
5. Bands of bluish mottled dolomite, mixed with patches of gray pure limestone and gray dolomite and bands of gray micaceous flagstone with fucoids	60

A mile or so north of the above section other strata, occur as follows:

6. Light gray more or less dolomitic sandstones and "some of which are fine grained, others are fine conglomerate." These åre interstratified with bands of white sandstone	630
7. Bluish thin bedded argillaceous flagstones and slates, containing *Conocephalites arenosus* and fucoids	60
8. Bluish and yellowish mottled dolomite	120
9. Yellowish and yellowish-gray sandy dolomite	600

Still further north, on the Canada line, there are additional strata, though not well exposed, but in general Sir William gives them as follows:

10. Buff and whitish sandy dolomite, holding a great amount of black and gray chert in irregular fragments of various sizes up to a foot in length and six inches wide. There are also masses of white quartz. Thickness (conjectured)	790

Most of the layers are not fossiliferous, and in few are fossils abundant. It may be true that fossils are really more common than they seem to be, for they only occur as casts, and, with the exception of the Algæ, these are rarely visible except when the surface of the stone has weathered so as to leave them in relief, and of course this only happens occasionally. Near Burlington, where the stone is extensively quarried for building purposes, some of the layers exhibit abundant casts of Algæ together with mud cracks, ripple marks and other evidences of shallow water formation. Farther north, at Georgia, and still more to the north at Highgate, various trilobites and Mollusca have been found of the genera Paradoxides, Conocephalites, Camerella, Orthisina, Obolella, &c. (see No. 4 above). The dolomitic portion of the beds constitute what has long been known as the "Winooski marble," to which I wish to call especial attention in the following pages.

The beds of "marble" appear first one or two miles north of Burlington and extend in a somewhat interrupted series north through St. Albans and end between that place and Swanton. Some of the layers are quite distinct from the red sandrock proper, others pass into it by imperceptible gradations. Ordinarily the marble beds are far less siliceous than the main bulk of the sandstone, often containing only one-seventh as much silica as that usually contains, or even less, but they are always much harder than ordinary marble. Analyses of the marble have been made but cannot be of great value when applied to the whole mass because the relative proportion of the substances composing it is extremely variable.

Identical results would scarcely be obtained from analyses of any two specimens taken at places a little distant from each other. Silica is always present, usually about ten per cent, lime carbonate forms from thirty to forty per cent, and magnesia carbonate about the same, while iron and alumina form a smaller portion of the mass.

No fossils had been discovered in this portion of the formation until a few years ago, when on looking over a pile of sawn fragments—refuse from the mill at Swanton—I noticed two or three pieces which contained evident fossils. These were afterwards identified by Mr. Billings as *Salterella pulchella*, described by him from the Straits of Belle Isle, and not hitherto known from Ver-

mont. It is only with difficulty that this fossil can be detected in uncut pieces of marble, but when blocks which contained specimens of it are sawn they are quite noticeable, as they are pure white and imbedded in the red stone, appear as small thimble-shaped, oval, conical or circular bodies, as they are cut in one or another direction. It seems probable that the Salterella occurs throughout the dolomitic beds, for I have found it at their extreme limits near Burlington and Swanton. The fossil is, however, not common anywhere. It occurs in patches sometimes as large as one's hand scattered over the slabs here and there. Other fossils also occur in the marble, but are not so well defined as to be certainly identified.

More than thirty years ago the beauty of the mottled dolomite attracted the attention of marble workers, and a quarry was opened about six miles from Burlington, and some of the blocks of stone taken out were sent to New York and Philadelphia to be sawn into slabs and polished. The results were, I believe, satisfactory in every way except financially. The stone made beautiful slabs for table tops and mantels, but its hardness, while adding to the beauty of the polish which it received, rendered the sawing and finishing so costly that after a short time the attempt to place it in the market was abandoned.

Later quarries were opened near St. Albans, and from these large quantities of stone have been taken, most of it to be manufactured at Swanton into floor tiling, for which it is admirably adapted. This enterprise still continues and has always been prosperous.

The most important attempt yet made to quarry and work up the Winooski marble was begun by a strong company only a short time ago at the old quarries near Burlington.

This company have large capital and have already made such thorough and extensive preparations to prepare the marble for market that if success can be attained in this direction it would seem certain to follow these efforts. Unfortunately, I think, this company have dropped the well-known name "Winooski marble," and substituted that of "Wakefield variegated marble," styling themselves the Wakefield Marble Company. It is no part of my purpose to advertise this company (though every one who knows of what it has accomplished and is trying to accomplish, and who is interested in the development of the resources

of the country, must be ready to wish it all success), for this would obviously be wholly out of place here. I think, however, that the possibility of obtaining at a not too great cost an abundant supply of beautiful marble which is unlike any other American marble, and which is fully equal to the finest imported marble for purposes of interior decoration, is a matter of interest to all. This is especially true because of the increasing rarity and costliness of imported marbles, and also because of the increasing demand for colored marbles in fine public buildings. That the Vermont variegated marble is fully equal to that which is imported is, so far as I know, the opinion of all experts who have examined both. In a pamphlet issued by the Wakefield company there are published letters from architects and marble workers which most emphatically declare this to be the fact. The late Hon. Geo. P. Marsh, in a letter written about a year before his death, says: "I have just returned from the national exposition at Florence. * * The brilliant reddish marbles are now very rare; and there was at the exposition none of the reddish class by any means equal to the Wakefield except in small fragments in mosaic work and the Sicilian jaspers."

The Wakefield or Winooski marble has been used in many public buildings in different portions of the country, notably in some of the corridors at the capitol at Albany as wainscoting, and also in the new wing of the Astor library in New York. It should be noticed here that while this marble is unrivaled for inside work it is not well adapted to situations in which it is exposed to the weather, as its colors fade and its beauty is greatly impaired when thus exposed. There seems to be great inequality in this respect in blocks from different layers. At least this is indicated in the appearance of blocks that have been for some years lying about the quarries. Some of these appear to be but very little changed, while others have their surfaces reduced to a nearly uniform yellowish-red. No one need fear any change in the appearance of polished slabs when protected from the inclemency of the weather.

Before attempting any description of the varieties of marble found in the Wakefield and other quarries, it may be well to notice some of the quarries themselves. The most extensive deposits are about the shores of Malletts bay, one of the most picturesque of the many lovely bays which indent the shores of

Lake Champlain. This bay is several miles in length and width and the marble crops out in cliffs from one hundred to two hundred feet high on both sides and forms islands in its midst. The supply is practically unlimited, and so located that huge blocks can be separated from the beds in the quarry, and by the same derrick which lifts them from these beds they may be placed in canal-boats or barges which may convey them by lake, canal and river either to New York or Montreal. In some parts of the cliffs the strata are easily separable, in other parts less easily, but almost anywhere large blocks, which prove sound and perfect throughout, may be obtained.

Perhaps the most remarkable characteristic of this marble is the wonderful variety of shade and general appearance which it presents.

Not only may slabs which are quite unlike each other be obtained from a block as it is sawn parallel with the stratification or transverse to it, any variation in the direction of the saws giving variety in the slabs; but even the opposite surfaces of the same slab may differ greatly. The rock in some of the layers is a more or less complete breccia, white or light-colored fragments being enclosed in a dark red paste. These fragments are of all sizes from those several inches long and wide to those no larger than the head of a pin. In some cases several adjacent bits were, when first held in the paste, one large piece, and subsequently broken, as the fractured edges of each exactly correspond to those of the pieces next it. The brecciated structure is conspicuously perfect in some blocks and quite imperfect in others, and it finally passes into what was evidently a pasty mass of nearly uniform fineness before consolidation took place. Some of the beds appear to have been much more thoroughly worked over, and the materials more completely ground and mixed than others, and the different varieties are in part due to this.

While but few colors are seen in the different layers, nevertheless these are mingled in such varying proportions as to produce unlimited diversity. Shades of red are especially abundant, so that almost every conceivable tint is found; less common are green, chiefly in olive shades, drab and rarely yellow, all mingled more or less abundantly with white. The different specimens may conveniently, though without absolute exactness, be arranged in several series. One of these would embrace those slabs in

which the red, which in most cases is the predominating color, is clear and decided. In this series we have many varieties from those in which the red is like that of jasper, or what is known as Indian red, to those in which it is simply a delicate pink like the lining of a shell. Another series gives us the red always of a brownish or chocolate cast, and this is sometimes very dark. This in turn passes through all intermediate shades to almost white. In a third series the red shades are less conspicuous, and with them are mingled greens and greenish-drabs or sometimes lavender shades. It is easy to understand how endless variation may be produced by varying combinations of these different shades with white. This is true both in the blotched and in the shaded layers. Those which show the brecciated structure more or less clearly vary as the fragments are large or small, and whether many large are mingled with many small or the reverse, and whether many large light fragments are mixed with dark small ones, or large dark bits with light small ones, and in the clouded or shaded layers light bands and blotches may predominate in one slab and dark bands in another. It will be obvious that no description of such marbles can convey to those who have not seen them very clear ideas of their appearance, and no attempt to describe all or nearly all of those found will be made. The company have for their own convenience and the purposes of trade, given names to over thirty varieties, all of which may be obtained within a very short distance from their mill on Malletts bay. A few of the leading sorts may properly be mentioned, and perhaps it will not be impossible to give a general idea of some of them. Nearest Burlington there are layers which possibly should be regarded as connecting the marble beds with the ordinary red sandrock. These are chiefly of a dark red slightly clouded and sprinkled with little grains of transparent quartz. This is veined with narrow veins of pure white lime carbonate, which is in pleasing contrast with the red about it. More rarely these veins are of quartz. The veins are usually not at all numerous, and often are only a small fraction of an inch in width. None of the varieties is so hard or so difficult to polish as this, and though handsome it is little used. An allied variety exhibits the white not as distinct veins but as mingled so completely with the red as to give a clouded appearance. Of course in the layers that are brecciated the colors are more or less distinct from each

other, and this is also true in some that show no breccia, for in these the colors are in blotches which may not blend to any great extent. One of the most richly shaded of all the varieties is what has been called "Ethan Allen." In this the clear red shades are in wavy bands, dark and light closely intermingled and constantly varying. Across these bands or waves are fine lines of clear white. This variety is finest when in large slabs, and as it receives a very brilliant polish it is very elegant. Some of the chocolate varieties are also very fine, and are admirably suited for wainscoting, mantels or other uses in rooms finished with dark woods. Of the lighter varieties of marble there are many. One of these is called "Florentine." In this the darker shades are mostly wanting, but the surface is covered with irregular blotches, usually not of large size, which are of a delicate pink or flesh color; with these are blotches of light tan and lavender, the whole mingled with white. Running across and through the blotches are lines of dark green. The effect of this combination of colors when a slab is polished is exceedingly beautiful. The "Bonfanti" is somewhat similar. The darker shades of red appear only as lines or small spots. The prevailing tints are pink, flesh color and salmon exquisitely mingled and blended with white and with each other. "Princess" is even more delicate and beautiful with its dainty blotches of lavender and ashes of roses, which give to the whole their peculiarly pleasing tints, while mingled with these are pink, salmon and rose shades and white.

A peculiar variety is "Opal." In this the red tints are largely absent, their place being taken by drabs and white. All of these pretty marbles receive without great difficulty a splendid polish, far more brilliant and durable than that of most of the white or clouded marbles. They are not easily scratched, do not grow dingy and are not stained readily. Ink and many other liquids, so injurious to the more completely calcareous marbles, does not affect these Wakefield varieties in the least. These advantages, aside from their great beauty, amply compensate for the greater cost of the harder marble. While, as has been shown, variety rather than uniformity is the rule among slabs of Wakefield marble, so that out of the hundreds of slabs which may be seen at any time in the store house of the company, no two can be found which are precisely alike (unless they were facing each other in

the block, for, of course, when the saw goes through a block the surfaces on each side of it must be alike), yet in most cases it is not very difficult to find a series sufficient for the wainscoting of a large room or the top of a long counter which match closely enough for all practical purposes.

While it has been my aim in what has been said of the different varieties mentioned to convey some idea of what they are, it is wholly impossible to place their beauty before the reader. No agate or jasper is more elegant or attractive. Indeed, in looking over slab after slab of the marble I have often been reminded of the close resemblance to agate which the surface before me presented. The Wakefield marble is, much of it, very similar to agate in brilliancy of polish, delicacy of color and general appearance, though quite unlike it in hardness and costliness. Nor do we ever see slabs of agate five or six feet wide and eight or ten feet long, as are some of the slabs of this marble.

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A BOTANICAL STUDY OF THE MITE GALL FOUND ON THE BLACK WALNUT.[1]

BY LILLIE J. MARTIN.

DEVOTEES to at least four sciences may do original work on *Erineum anomalum*. Since eggs have been found among the hairs on its surface and neither mycelium nor spores occur in it, it can no longer be ranked among the fungi, and the entomologist alone may study the life-history of its inhabitants. The chemist and physicist will certainly have somewhat to do if they set out to find the forces which are at work in the production of the gall. Nor will the botanist be without employment if he trace its anatomy and full development. This paper is a statement of what was seen in a somewhat superficial botanical examination of the gall during the month of July.

These galls usually occur in the walnut on the under side of the main petiole, somewhat below the first set of leaflets, but are occasionally found somewhat higher up. One or even seven or eight galls may be found on the same petiole (Figs. 1, 2, 3). When but one occurs the petiole is shortened and the leaf is rather smaller than the normal leaf; sometimes the petiole is slightly

[1] Read before the Section of Biology of the American Association for the Advancement of Science in the Philadelphia meeting, 1884.

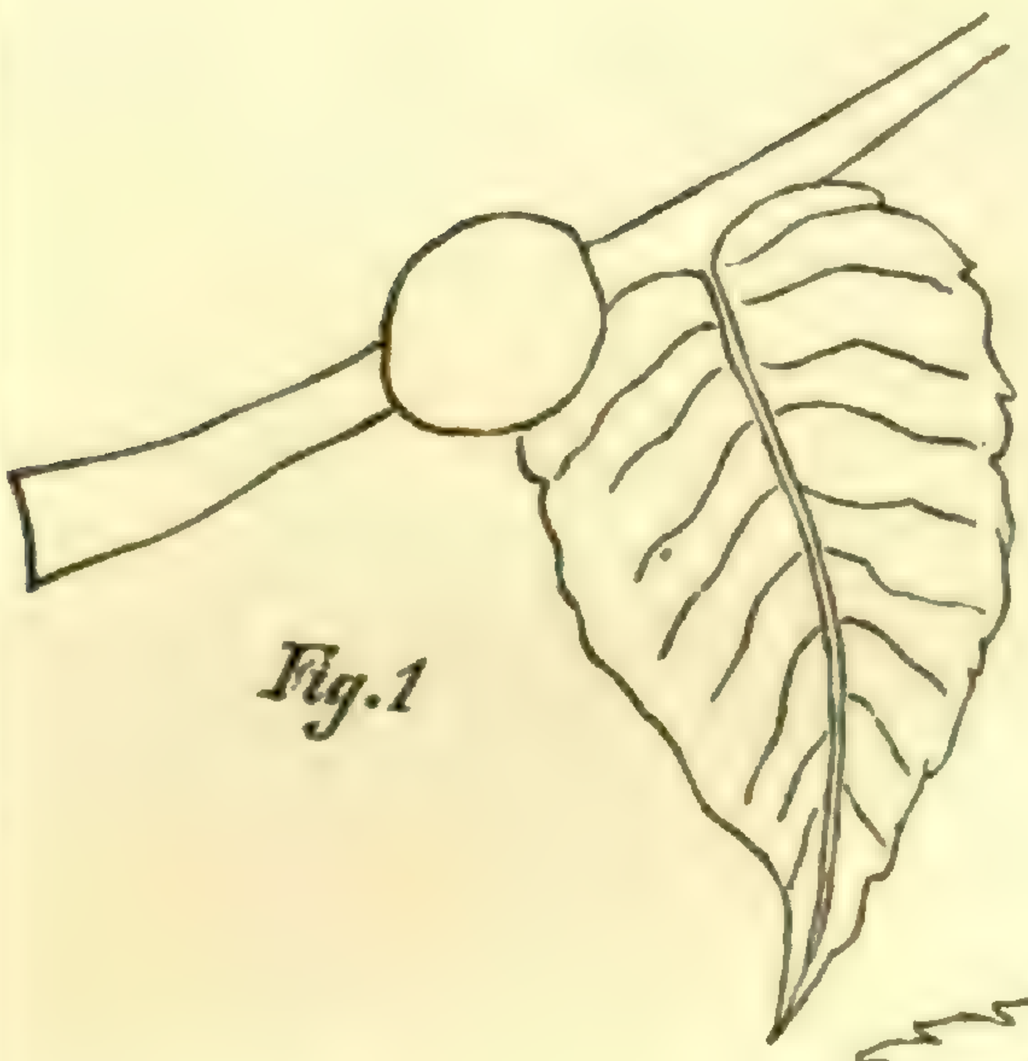


Fig. 1

Fig. 4

Fig. 2

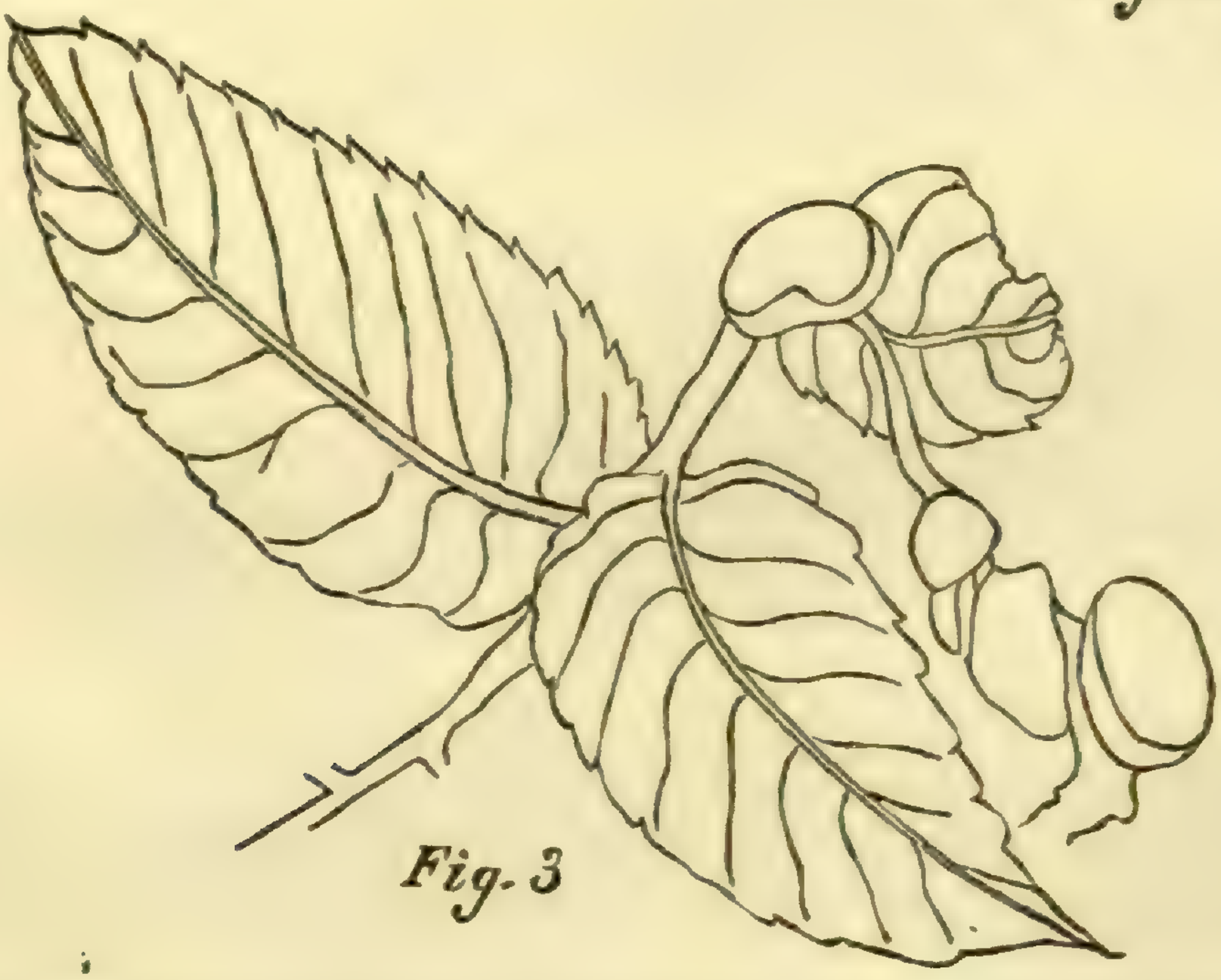


Fig. 3

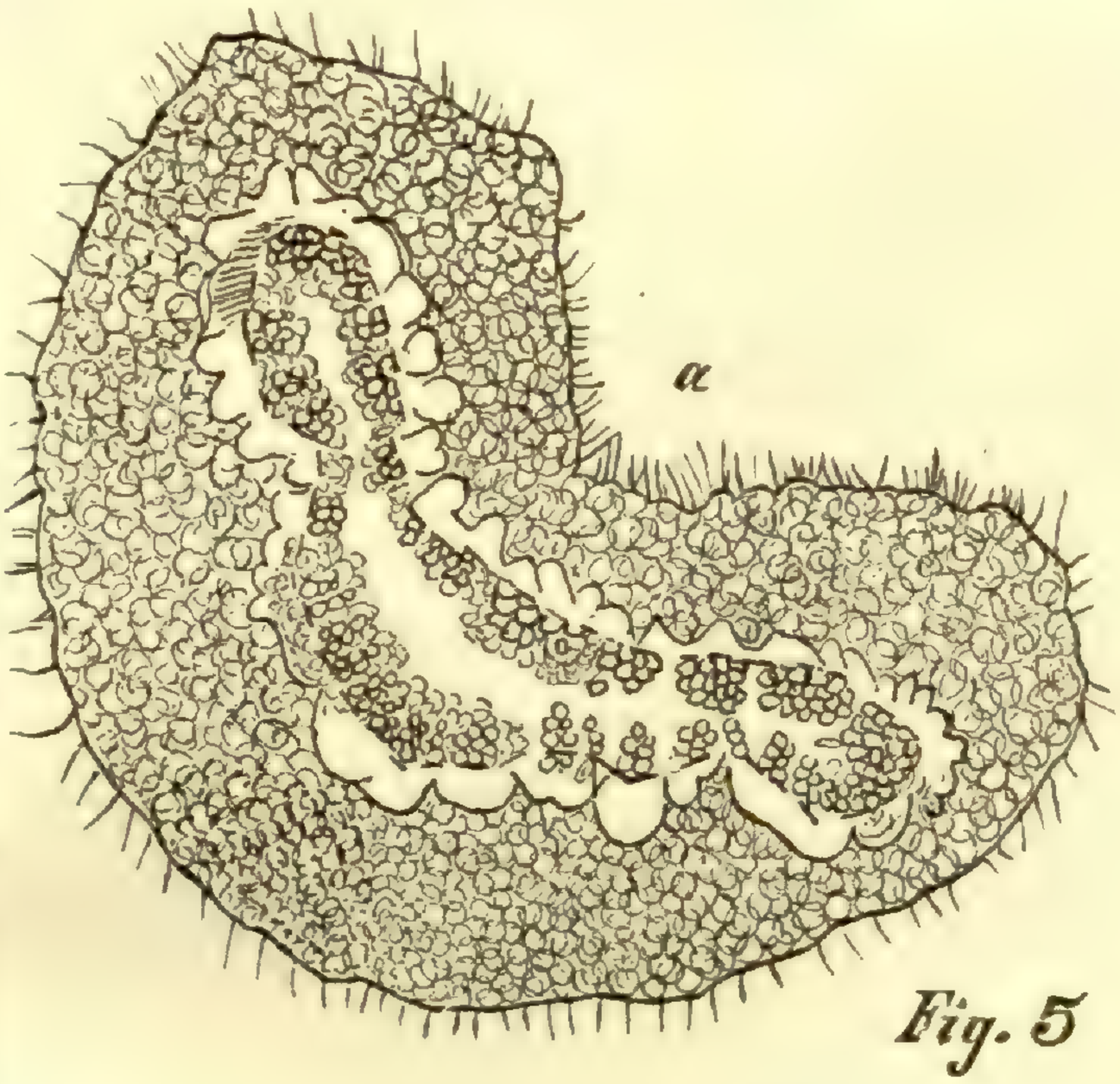
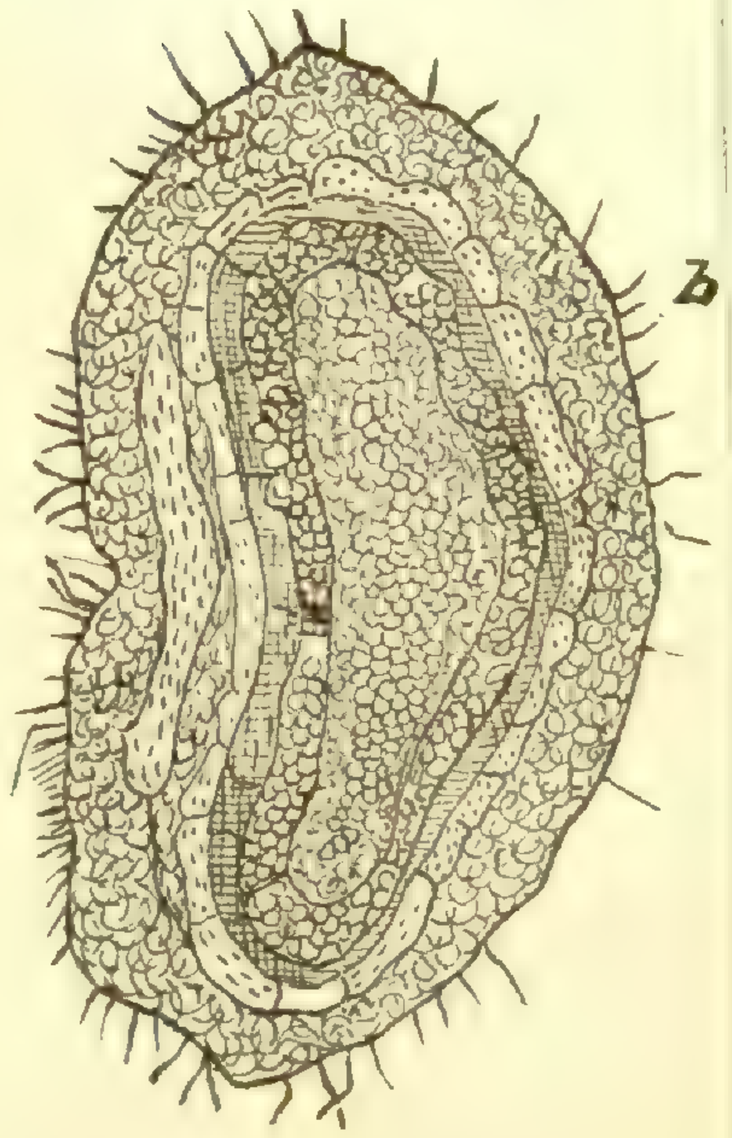
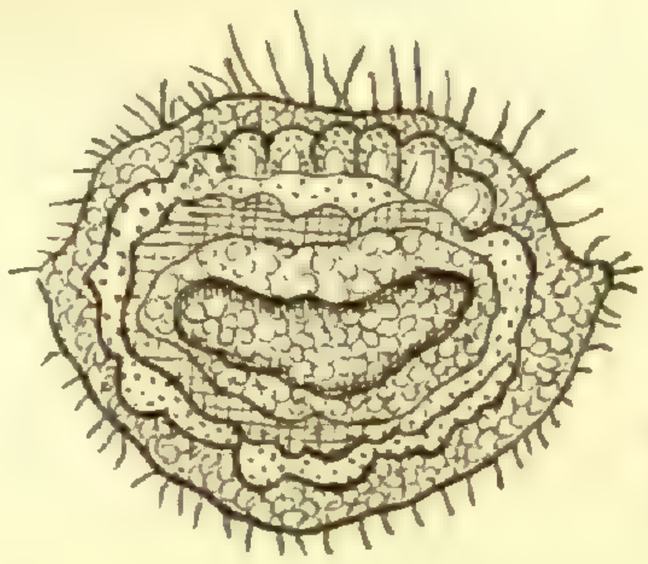


Fig. 5





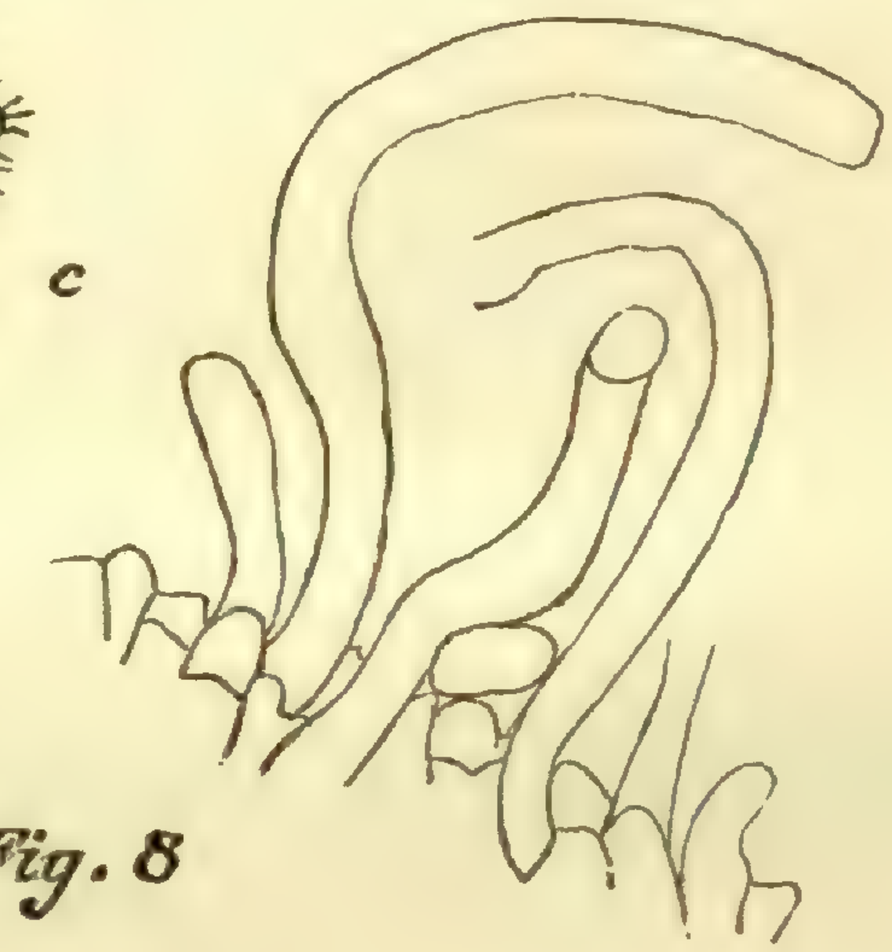


Fig. 8

Fig. 6

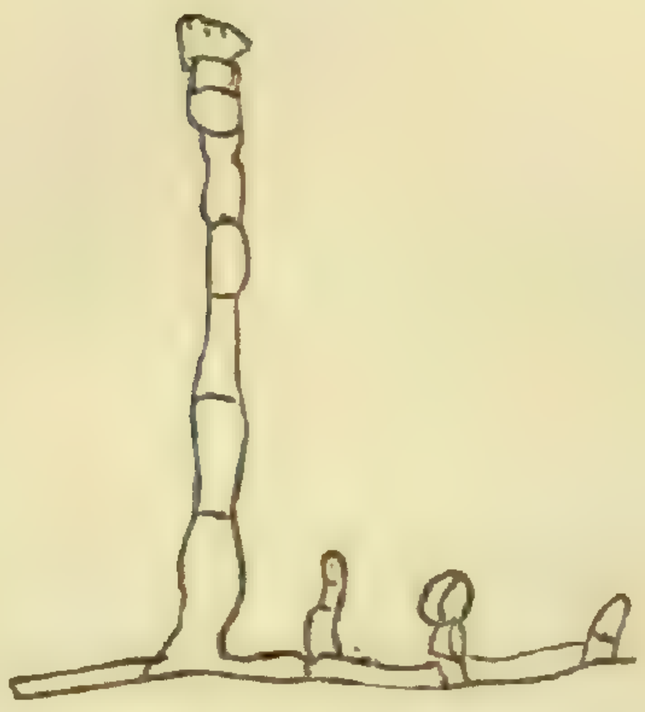


Fig. 7

bent from back to front also. In addition to these changes, when several galls are found on the same petiole (Fig. 3) this is often so much twisted as to bring them on the upper side of the leaf.

The galls are elliptical in shape, the longer axis varying in length from 3^{mm} to 15^{mm} and the shorter from 1^{mm} to 8^{mm}. From above they appear slightly convex; their centers are hairy and purplish-red in color and set in a green ring which is continued below into the petiole. Their average height is about 10^{mm}. In appearance they are not unlike buttons which have their tops mounted in metal holders.

The under surface of the gall is similar in general outline to its upper, as it abruptly contracts before passing into the petiole (Fig. 4), sometimes nearly clasping it either in the direction of its long or short axis. When several galls grow on the same petiole they may either run together or be entirely separate. If they coalesce great changes in size and shape are produced.

The normal petiole is usually horizontal, but sometimes twists the leaf half way round (herbarium specimens). The cross section of the petiole near its base is of a reniform shape on account of a crease in its upper surface. The crease disappears further from the base of the petiole, which then appears elliptical in cross section.

The fibro-vascular bundles of the normal petiole of the walnut are such as are ordinarily found in the stems of dicotyledonous plants. The bundle is better developed as the apex of the petiole is approached. Even here, however, the bast is more abundant than the corresponding wood. An examination of that part of the petiole where the crease has disappeared shows a second row of well developed fibro-vascular bundles. Almost no trace of this can be seen in the lower part of the petiole (Fig. 5).

Under a low power of the microscope a longitudinal radial section of that part of the gall near the pith of the petiole resembles a drawing of a geological section of the earth in which the strata are very much bent and folded (Fig. 10). The cells themselves are bent, but the folding takes place mainly between contiguous cells. In comparing cross and longitudinal-radial sections of the gall (Figs. 9 and 10) the bast is found to be quite as abundant as in the normal petiole, but is spread over a wider area. The wood, too, is as scanty as before. The tracheary vessels have almost entirely disappeared. Tracheids have not only

supplied their place but mainly compose that part of the gall that is made up of folded tissue. Two or three layers of the pitted cells near the pith are wider than long and regular in shape.

As the distance from the pith increases the cells increase in length and decrease in breadth until they are two or three times longer than broad. Owing to the crowding to which they are exposed, they become irregular in shape nearer the surface of the fibro-vascular bundle.

In the normal petiole the cells overlying the fibro-vascular bundle are longer than broad, regular in shape and contain but little protoplasm. The corresponding part in the galls is made up of much larger cells, irregular in form and filled with a granular substance which is slightly colored yellow by iodine, and red by eosin.

Clustered and glandular hairs are found irregularly distributed over the petiole. The clustered hairs (Fig. 6) are found abundantly on the upper side of the petiole near its base. From this point their number decreases though there are still more on the upper side of the petiole than on the lower. They originate from cells of the epidermis which have crowded together in papilla-like masses. But one hair arises from each cell. Each papilla may have but one hair, though it will often have nine or ten. The ordinary number is five or six. The hairs themselves are one-celled and pointed toward the apex. At the extremity their walls are so thickened as to nearly obliterate the cavity. They are thinner towards the base, and iodine shows protoplasm to be present.

The glandular hairs vary in shape. In a general way they are made up of several cells, the terminal cell being larger than those below, and secreting an "acrid aromatic" substance. Iodine shows that there is protoplasm in their cells. These glandular hairs arise from single epidermal cells which are separate from each other by two or three intervening cells.

The galls have no differentiated epidermis. Certain cells which from their position would be called epidermal are without protoplasm, but in other respects resemble those beneath. From nearly every one of the epidermal cells cylindrical, one-celled hairs arise (Fig. 8). These hairs seem to be a continuation of the epidermis. They are about 1^{mm} in length and $\frac{1}{10}$ ^{mm} in diameter, that is, at least twice as long and broad as the normal hairs.

PLATE VI.

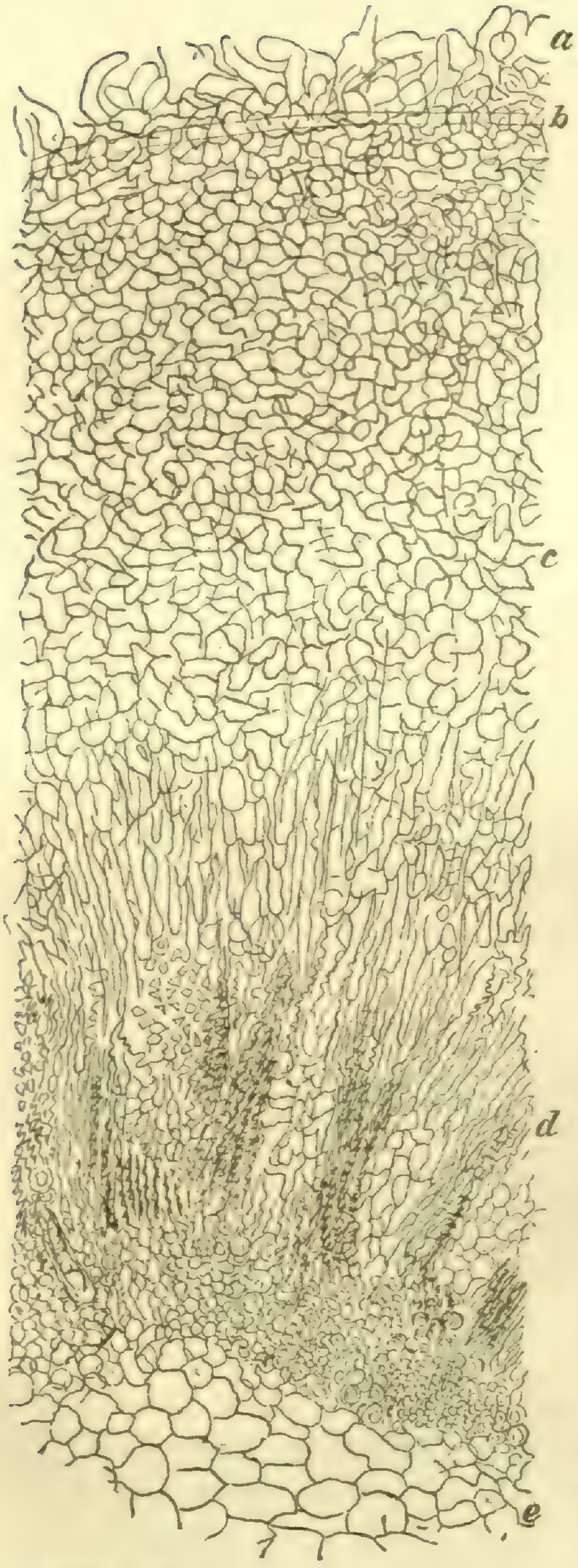


Fig. 9

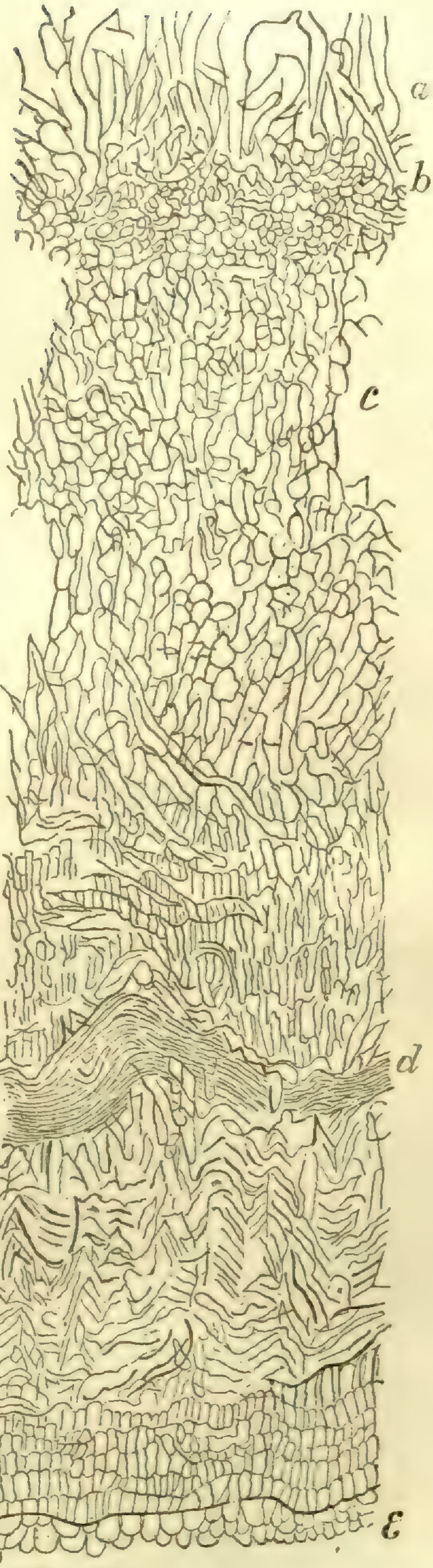


Fig. 10.

These cells contain a purplish-red coloring matter which is soluble in water. If this is removed the cells are found to contain a large quantity of a brown granular substance. The hairs of the gall are so unlike normal hairs in shape, position, contents and origin that they can scarcely be looked upon as modified trichomes. Ensconced among the hairs which are distributed over the surface of the gall are found the eggs of the mite which produces it.

In order to know the changes which the gall has undergone in reaching its mature state, it would be necessary to make a careful study of the specimens of the gall from its first appearance to its full development. I hope to do this in the future. Possibly it may not be too presumptuous to venture a few predictions founded on a comparison of the gall with the normal petiole in regard to development:

1. The gall must have started very early. The fact that the gall hairs cannot be looked upon as modified trichomes has been already referred to. Vestiges of the normal trichomes would be found among the gall hairs if the petiole had been far enough advanced for them to appear, but no such remains are found. The epidermal cells of the gall are so thin-walled and so unlike the thick-walled and regular epidermal cells of the petiole in form, that they could have originated from them only at an early period. Comparison of the tissue beneath the epidermis in the gall and petiole does not suggest that one was derived from the other.

2. The development was doubtless inward, the stimulant, no matter of what nature, acting on the outside. The position of the eggs, the mode of oviposition of mites and the fact that no sign of their having pierced the tissue can be found, suggests this. The bending and folding of the fibro-vascular tissue would seem to suggest that the stimulant caused a greater growth in length than in breadth, and this produced the lateral pressure which pushed up the tissue.

3. The value of these various modifications to the mite may be seen in a general way. The hairs of the gall give the very best protection to the eggs, the parenchyma is an excellent cushion and is firmly supported by the tracheids which, with the other

portions of the fibro-vascular systems may also serve their usual purpose of conductors of water.

EXPLANATION OF PLATES.

PLATE IV.

FIG. 1.—Sketch of a gall showing its ordinary form, size and position. Natural size.

FIG. 2.—Sketch of the gall showing its appearance when found above the first set of leaflets.

FIG. 3.—Several galls on the same petiole showing the effect on stem and the general arrangement and shape of the galls when more than one occurs on the same petiole.

FIG. 4.—Cross section of gall and petiole, showing internal appearance of gall.

PLATE V.

FIG. 5.—Cross sections of normal petiole; *a*, at base, no well-developed second row of fibro-vascular bundles; *b*, below first pair of leaflets, appearance of second row of fibro-vascular bundles; *c*, above first pair of leaflets, a well-developed second row of fibro-vascular bundles. × 25.

FIG. 6.—Clustered hairs. × 165.

FIG. 7.—Glandular hairs. × 165.

FIG. 8.—Gall hairs, extensions of epidermal cells.

PLATE VI.

FIG. 9.—Cross section of petiole and gall; *a*, gall hairs which appear to be continuations of the epidermis *b*; *c*, parenchyma beneath the epidermis; *d*, fibro-vascular bundles in which tracheids have supplied the place of tracheary and other vessels; *e*, parenchyma of the pith (highly magnified).

FIG. 10.—Longitudinal-radial section of petiole and gall; *a*, *b*, *c*, *d*, *e*, as in fig. 9 (highly magnified).

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ON THE EVOLUTION OF THE VERTEBRATA, PROGRESSIVE AND RETROGRESSIVE.

BY E. D. COPE.

I. PRELIMINARY.

IN attempting to ascertain the course of evolution of the Vertebrata, and to construct phylogenetic diagrams which shall express this history, among the difficulties arising from deficient information, one is especially prominent. As is well known, there are many types in all the orders of the Vertebrata which present us with rudimentary organs, as rudimental digits, feet or limbs, rudimental fins, teeth and wings. There is scarcely an organ or part which is not somewhere in a rudimental and more or less useless condition. The difficulty which these cases present is, simply, whether they be persistent primitive conditions, to

be regarded as ancestral types which have survived to the present time, or whether, on the other hand, they be results of a process of degeneration, and therefore of comparatively modern origin. The question, in brief, is, whether these creatures presenting these features be primitive ancestors or degenerate descendants.

In the first place let us define the meaning of the word degenerate. This must be done first from a structural or anatomical standpoint. Degeneracy may be defined as a loss of parts without corresponding development of other parts. All animals are degenerate in some respect or another, as, for instance, the Mammalia in the small size of the pineal gland and of the coracoid bone; so that degeneracy, as a whole, can only be affirmed where the sum of the subtractions is greater than the sum of the additions. Function of the parts must, however, be consulted in this matter. We naturally regard sensibility as the highest of animal functions, and mind as the highest form of sensibility. Therefore development of organs of sensibility and sense and mind constitutes a better claim of progress than development of stomach or of skin. Since motion is under the direction of sensibility, organs of movement have much to do with the question. When perfection in this respect conflicts with perfection of brain, in evidence of position, we naturally give the preference to the latter in deciding. Thus the ruminating mammals are much superior to man in the structure of their feet, teeth and stomach, yet we properly assign the higher position to the quadrumana and to man, on account of the superior complication of their brain structure.

Palæontology has proven[1] what had been already surmised, that the development of animal organisms has been on lines of increasing specialization of parts. That is, in lines of increasingly perfect adaptations of structures to ends, or functions. In certain series of animals we witness steadily increasing perfection of mechanisms of the limbs for running; in others for digging; in others for flying. In the teeth we find increasing perfection of machines for grinding, for cutting or for seizing. In the brain the specialization has evidently been towards increased acuteness of perception, increased energy of action, and increased intelligence. Specialization does not, however, necessarily imply progressive development. Adaptation may be to a parasitic or a

[1] Cfr. "On the Evidence for Evolution in the History of the Extinct Mammalia;" Proc. Amer. Assoc. Adv. Sciences for 1883.

sessile mode of life. Such adaptation is often displayed in a very special modification of parts, as in the anterior limbs of some of the parasitic Crustacea; in the mouth parts of some Arachnida; in the feet of the sloth, and in the jaws of the ant-eaters.

Embryology has furnished, and will furnish, many important hints and demonstrations as to the true meaning of the rudimentary condition or absence of parts, and thus indicate the phylogenetic connections of animals. Thus the origin of the Tunicata from primitive vertebrate-like forms would probably never have been suspected but for embryological studies; and the origin of the very peculiar order of Rotifera has been explained in like manner. But embryology has its limitations, for the transitional characters presented by embryos are only partially of the nature of a record of the structures which belonged to their ancestors in successive geological ages, and are frequently special adaptations to the necessities of their embryonic life. Such are the statoblasts which are present in fresh-water sponges and Polyzoa, and wanting in the marine forms; and the allantois and placenta of Vertebrata. In a number of groups the embryo seems to have been more susceptible to the influence of the environment than the adults.[1] It results that in many cases the phylogeny can only

[1] A remarkable instance of this state of things appears in the history of the evolution of the insects. It is quite impossible to understand this history without believing that the larval and pupal states of the highest insects are the results of a process of degeneracy which has affected the middle periods of growth but not the mature results. The earliest insects are the Orthoptera, which have active aggressive larvæ and pupæ, undergoing the least changes in their metamorphosis (Ametabola) and never getting beyond the primitive mandibulate condition at the end. The metamorphosis of the jawed Neuroptera is little more marked, and they are one of the oldest orders.

The highest orders with jaws undergo a marked metamorphosis (Coleoptera, Hymenoptera), the Hymenoptera even requiring artificial intervention in some instances to make it successful. Finally the most specialized orders, the suctorial Diptera and Lepidoptera, especially the latter, present us with very unprotected more or less parasitic stages, both active and inactive. These animals have evidently degenerated, but not so as to prevent their completing a metamorphosis necessary for purposes of reproduction. As is well known, many imagines (Saturniidæ, Œstridæ) can perform no other function, and soon die, while in some Diptera the incomplete larvæ themselves reproduce, so that the metamorphosis is never completed.

This history is parallel to that proposed by Dohrn to account for the origin of the Ammocœtes larval stage of the Marsipobranchii. He supposes this form to be more degenerate than its probable ancestral type in the ancestral line of the Vertebrata, as it is inferior to its own adult. An inactive life in mud is supposed by Dohrn to have been the effective cause. An inactive life on the leaves of plants, or in dead carcases, has probably been the cause of the same phenomenon in the Lepidoptera and Diptera.

be determined by the discovery and investigation of the ancestors themselves, as they are preserved in the crust of the earth. In all cases this discovery confirms and establishes such definite conclusions as may be derived from embryology. It is also clear that on the discovery of phylogenetic series it becomes at once possible to determine the nature of defective types. It becomes possible to ascertain whether their rudimental parts represent the beginnings of organs, or whether they are the result of a process of degeneration of organs once well developed.

A great deal of light has been happily thrown on this question as regards the Vertebrata, by the recent work done in North American palæontology. The lines of descent of many of the minor groups have been positively determined, and the phylogenetic connections of most of the primary divisions or classes have been made out. The result of these investigations has been to prove that the evolution of the Vertebrata has proceeded not only on lines of acceleration but, to a much greater extent than has been heretofore suspected, on lines of retardation.[1] That is, that evolution has been not only progressive, but at times retrogressive. This is entirely in accord with the views derived by Dohrn from embryology,[2] who, however, wrote only of the origin of the Vertebrata as a whole and not of its divisions, excepting only the Leptocardii and Marsipobranchii, that is, of the sand lance and the lampreys and hags. The demonstration of such relations for the higher Vertebrata is now done nearly for the first time.[3]

Omitting from consideration the two classes above mentioned, whose remains have not yet been certainly found in a fossil state,

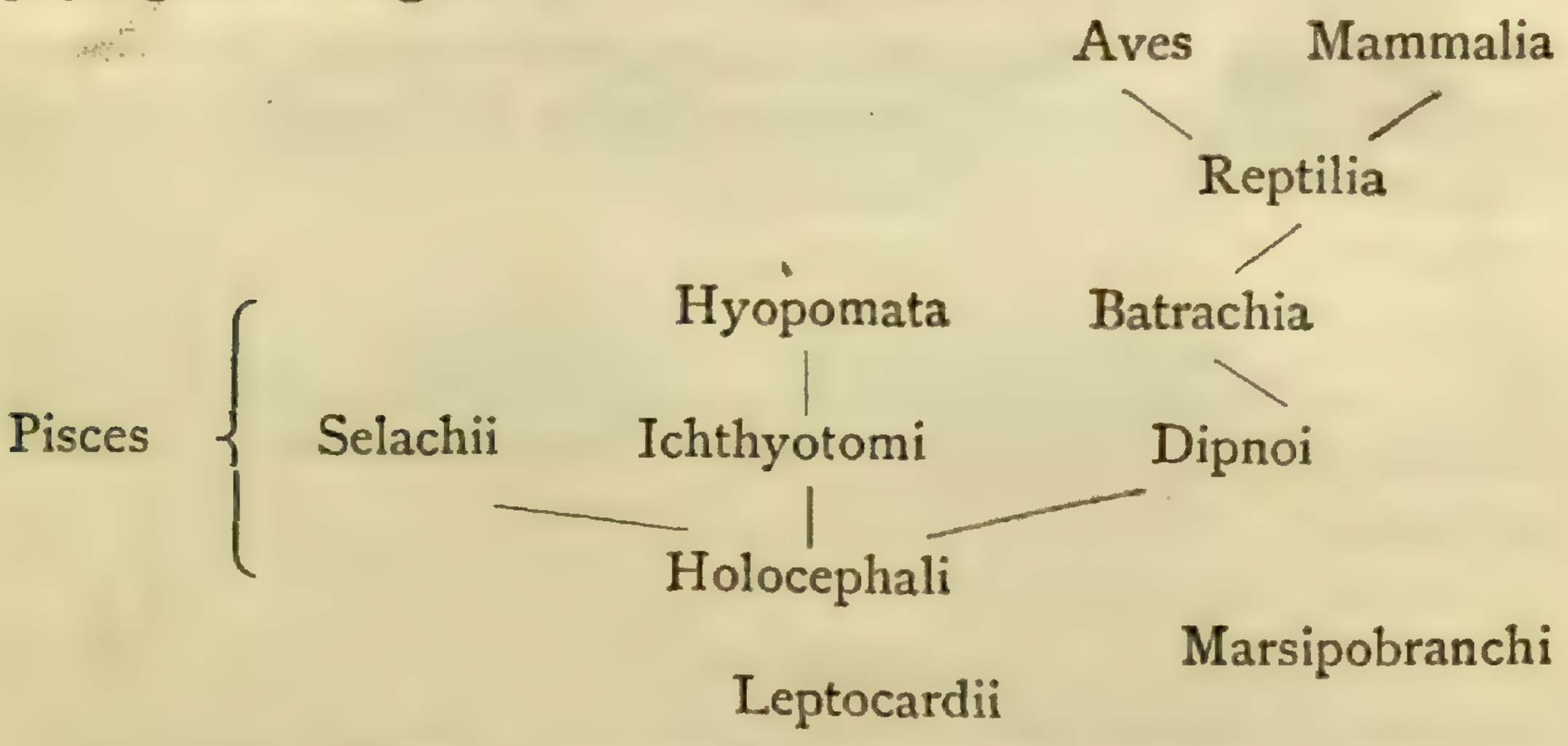
[1] See Origin of Genera, E. D. Cope, Philadelphia, 1868, where these terms are introduced.

[2] See Der Ursprung der Wirbelthiere u. d. Princip des Functionwechsels, Leipsic, 1875.

[3] On the Phylogeny of the Vertebrata, Cope, AMER. NATURALIST, Dec., 1884. I here remark that my researches have now, as I believe, disclosed the ancestry of the mammals, the bird, the reptiles and the true fishes, or Hyopomata, including the special phylogenies of the Batrachia and Reptilia, and some of the Mammalia. See the following references: AMERICAN NATURALIST, 1884, p. 1136; Proceedings Academy Philadelphia, 1867, p. 234; Proceedings American Philosoph. Society, 1884, p. 585; AMERICAN NATURALIST, 1884, p. 27; Proceedings American Association for the Advancement of Science, XIX, 1871, p. 233; Proceedings American Philosophical Society, 1882, p. 447; AMERICAN NATURALIST, 1884, pp. 261 and 1121; Report U. S. Geol. Survey W. of 100th Mer., G. M. Wheeler, 1877, IV, II, p. 282.

there remain the following: the Pisces, Batrachia, Reptilia, Aves and Mammalia.

The Mammalia have been traced to the theromorphous reptiles by the Monotremata. The birds, some of them at least, appear to have been derived from the Dinosaurian reptiles. The reptiles in their primary representative order, the Theromorpha, have been probably derived from the rhachitomous Batrachia. The Batrachia have originated from the sub-class of fishes, the Dipnoi, though not from any known form. I have shown that the true fishes or Hyopomata have descended from an order of sharks,[1] the Ichthyotomi, which possess characters of the Dipnoi also. The origin of the sharks remains entirely obscure, as does also that of the Pisces as a whole. Dohrn believes the Marsipobranchii to have acquired its present characters by a process of degeneration. The origin of the Vertebrata is as yet entirely unknown, Kowalevsky deriving them from the Ascidians, and Semper from the Annelida. The above results I have embodied in the following phylogenetic diagram:



Accepting this phylogeny, it becomes possible to determine the course of development first of the whole series; and secondly of the contents of each class taken by itself. I will first consider the direction of the evolution of the Vertebrata as a whole.

II. The Vertebrate Line.

The Vertebrata exhibit the most unmistakable gradation in the characters of the circulatory system.[2] It has long been the

[1] Proceedings Am. Phil. Soc., 1884, p. 585.

[2] See Origin of Genera, 1868, p. 20, for a table of the characters of the circulatory system.

custom to define the classes by means of these characters, taken in connection with those of the skeleton. Commencing in the Leptocardii with the simple tube, we have two chambers in the Marsipobranchii and fishes; three in the Batrachia and Reptilia; and four in the Aves and Mammalia. The aorta-roots commence as numerous pairs of branchial arteries in the Leptocardii; we see seven in the Marsipobranchi, five in the fishes (with number reduced in some); four and three in Batrachia, where they generally cease to perform branchial functions; two and one on each side in Reptilia; the right hand one in birds, and the left hand one in Mammalia. This order is clearly an ascending one throughout. It consists of first, a transition from adaptation to an aquatic to an aërial respiration; and second, an increase in the power to aërate and distribute a circulating fluid of increased quantity, and of increased calorific capacity. In other words, the circulation passes from the cold to the hot-blooded type coincidentally with the changes of structure above enumerated. The accession of a capacity to maintain a fixed temperature while that of the surrounding medium changes, is an important advance in animal economy.

The brain and nervous system also display a general progressive ascent. Leaving the brainless Leptocardii, the Marsipobranchs and fishes present us with small hemispheres, larger optic lobes and well-developed cerebellum. The hemispheres are really larger than they appear to be, as Rabl Rückard has shown[1] that the supposed hemispheres are only corpora striata. But the superior walls are membranous, and support on their internal side only a layer of epithelial cells, as in the embryos of other Vertebrata, instead of the gray substance. So that although we find that the cerebellum is really smaller in the Batrachia and most Reptilia than in the fishes, the better development of the hemispheres in the former gives them the preëminence. The Elasmobranchii show themselves superior to many of the fishes in the large size of their corpora restiformia and cerebellum. The Reptilia constitute an advance on the Batrachia. In the latter the optic thalami are, with some exceptions, of greater diameter than the hemispheres, while the reverse is generally true of the reptiles. The crocodiles display much superiority over the other

[1] Biologisches centralblatt, 1884, p. 449

reptiles in the larger cerebellum, with rudimental lateral lobes. The great development of the hemispheres in birds is well known, while the general superiority of the brain of the living Mammalia over all other vertebrates is admitted.

The consideration of the successive relations of the skeleton in the classes of vertebrates embraces, of course, only the characters which distinguish those classes. These are not numerous. They embrace the structure of the axis of the skull; of the ear bones; of the suspensors of the lower jaw; of the scapular arch and anterior limb, and of the pelvic arch and posterior limb. Other characters are numerous, but do not enter into consideration at this time.

The persistence of the primitive cartilage in any part of the skeleton is, embryologically speaking, a mark of inferiority. From a physiological or functional standpoint it has the same significance, since it is far less effective both for support and for movement than is the segmented osseous skeleton. That this is a prevalent condition of the lower Vertebrata is well known. The bony fishes and Batrachia have but little of the primitive cartilage remaining, and the quantity is still more reduced in the higher classes. Systematically then, the vertebrate series is in this respect an ascending one. The Leptocardii are membranous; the Marsipobranchii and most of the Elasmobranchii cartilaginous; the other Pisces and the Batrachia have the basicranial axis cartilaginous, so that it is not until the Reptilia are reached that we have osseous sphenoid and presphenoid bones, such as characterize the birds and mammals. The vertebral column follows more or less inexactly the history of the base of the skull, but its characters do not define the classes.

As regards the suspensor of the lower jaw the scale is in the main ascending. We witness a gradual change in the segmentation of the mandibular visceral arch of the skull, which clearly has for its object such a concentration of the parts as will produce the greatest effectiveness of the biting function. This is accomplished by reducing the number of the segments, so as to bring the resistence of the teeth nearer and nearer to the power, that is, the masseter and related muscles, and their base of attachment, the brain-case. This is seen in bony Vertebrates in the reduction of the segments between the lower jaw proper and the skull, from four to none. In the fishes we have the hyomandibular, the sym-

plectic, the inferior quadrate, and the articular. In the Batrachia, reptiles and birds, we have the quadrate and articular only, while in the Mammalia, these elements also are wanting.

The examination of the pectoral and pelvic arches reveals a successive modification of the adaptation of the parts to the mechanical needs of the limbs. In this regard the air-breathing types display wide diversity from the gill-bearing types or fishes. In the latter, the lateral elements unite below without the intervention of a median element or sternum, while in the former the sternum or parts of it, are generally present. Either arrangement is susceptible of much mechanical strength, as witness the Siluroid fishes on the one hand, and the mole on the other. The numerous segments of the fishes' pectoral arch must, however, be an element of weakness, so that from a mechanical standpoint it must take the lowest place. The presence of sternal elements, with both clavicle, procoracoid, and coracoid bones on each side, gives the Reptilia the highest place for mechanical strength. The loss of the coracoid seen in the tailed Batrachia, and loss of coracoid and procoracoid in the Mammalia, constitute an element of weakness. The line is not then one of uniform ascent in this respect.

The absence of pelvis or its extremely rudimental condition in fishes, places them at the foot of the line in this respect. The forward extension of the ilium in some Batrachia and in the Mammalia, is to be compared with its backward direction in Reptilia, and its extension both ways in the birds. These conditions are all derived by descent from a strictly intermediate position in the Batrachia and Reptilia of the Permian epoch. The anterior direction must be regarded as having the mechanical advantage over the posterior direction, since it shortens the vertebral column and brings the posterior nearer to the anterior feet. The prevalence of the latter condition in the Mammalia enables them to stand clear of the ground, while the Reptilia move with the abdomen resting upon it. As regards the inferior arches of the pelvis, the Mammalia have the advantage again, in the strong bony median symphysis connecting the ischium and pubis.[1] This character, universal among the land Vertebrata of the Permian epoch, has been lost by the modern [redacted] Reptilia, and birds, and is retained only by the Mammalia. So the line, excepting the Mam-

[1] This is an advantage as a protection during gestation.

malian, have *degenerated* in every direction in the characters of the pelvis.

The limbs of the Pisces are as well adapted to their environment as are those of the land Vertebrata, but from an embryological standpoint, their structure is inferior. The primitive rays are less modified in the fin than in the limb; and limbs themselves display a constantly increasing differentiation of parts, commencing with the Batrachia and ending with the Mammalia. The details of these modifications belong to the history of the contents of the classes however, rather than to the succession of the Vertebrata as a whole.

In review it may be said, that a comparison of the characters which define the classes of the Vertebrates, shows that this branch of the animal kingdom has made with the ages successive steps of progress from lower to higher conditions. This progress has not been without exception, since as regards the construction of the scapular arch, the Mammalia have retrograded from the reptilian standard, as a whole.

In subsequent articles I shall take up the lines of the classes separately.

(*To be continued.*)

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

——The annual report for 1883–4 of Professor Agassiz to the president and fellows of Harvard College, on the condition of the Museum of Comparative Zoölogy, contains much matter of interest to the naturalist on the subject of the accumulation and care of collections. The director of the museum thinks that it is not advisable to create collections which "must undoubtedly be duplicated in Washington or New York." That portion which relates to the care of the perishable materials contains many suggestive statements. Among these is the information that the large collections of reptiles, fishes, mollusks, Crustacea and echinoderms in alcohol, made by the museum, have become in great degree useless for nice scientific work, and that every year much material has to be thrown away. Such a statement as this must be equally applicable to all museums. That it should be true is greatly to be regretted, and points clearly to the

necessity of using more efficient methods or materials for preservation in future. While in the language of Professor Agassiz, "Undoubtedly many most interesting problems require large collections for their solution, the cost of maintaining" the collections of perishable specimens. "may stagger the most enthusiastic collector." "The function of a museum is without doubt to use its resources in the purchase and care of special collections," but at the same time, "with the present facilities and cost of travel it would be far cheaper for an institution to supply the specialist with the necessary funds for such an investigation" (as that of recent fishes). The general result of these somewhat opposing considerations is, that while there is no limit, excepting that of space, to the extent to which collections of imperishable materials can be carried, it is better not to accumulate collections which may be duplicated elsewhere, or large quantities of perishable specimens. For the study of this class of objects the money of institutions is more profitably expended in furnishing specialists with facilities and fresh materials.

It is evident, however, that even historical collections of perishable material must accumulate. It is also true that students must have such collections as the means of obtaining the education necessary as a preliminary to research, and for the purpose of studying the coarser anatomy. Moreover, while distinctness of character should be sought by every museum, it is not certain what material may [illegible] be duplicated elsewhere, and every important locality should have its reference collection as complete as circumstances permit. How to do this more perfectly and economically is one of the problems of the day.

—— The School of Biology of the University of Pennsylvania has been established, as we understand, for the purpose, first, of sustaining and conducting original research; and second, to furnish incidentally to this leading object instruction to persons desirous of making of research a pursuit. No measures will be spared to carry these intentions into effect. Such an institution has long been needed in Philadelphia, and the reputation of the city as a factor in the scientific growth of the country is much concerned in it. The possibility of realizing this project is almost entirely due to the generosity of Professor Horace Jayne, who has sustained much of the necessary expense of the establishment. The appropriation of money to forward the intellectual

development of a community is one of the most effective ways of elevating it in all respects, as it applies energy to the root of the matter instead of attempting to mend the leaves and fruit. It is a prophylactic, while much of the charity of the world has rather the character of a curative. All students will unite in the hope that Professor Jayne's liberality will meet with the fullest appreciation, and bring him due reward.

—— Communication with our neighboring republic on the south, is now easy. The opening of the Mexican Central Railroad brings the City of Mexico within seven days of the Eastern United States, and it will not be long before through travel to Guatemala by rail will be possible.

Naturalists need not be reminded of the richness of this magnificent country in all that interests and delights them. The region embraced by it and the republics to the south of it, are characterized by the remarkable variety of their animal and vegetable productions, the number of species of animals, at least, being much greater in a given area than in the North American region. The species of the higher classes are being rapidly made known, but the investigation of those forms of life which require to be studied in the country itself, has scarcely commenced. Both inland and on the sea coast a field lies open which will tempt specialists, and some of our schools of biology will doubtless establish laboratories and inaugurate explorations in the near future. The cheap and good living to be had in the country is not the least of the facilities to be found in Mexico.

—— In his attractive article in the *Contemporary Review* entitled Würzburg and Vienna, M. Lavelaye writes of Ludwig Noiré's new book, Das Werkzeug (E. [illegible]) which proves the truth of Franklin's saying: "Man o[illegible] Profol-making creature." Noiré says that the origin of tools dates from the origin of reason and language. He thus accounts for the origin of language. In the beginning, as far back as we can conceive, man was forced to act on matter to obtain food. This action in nature for the purpose of satisfying wants, is labor. As men were living together in families and in tribes, labor was carried on in common. A person making a muscular effort very naturally pronounces certain sounds in connection with the effort he is making. These sounds, repeated and heard by the entire group, were after a time understood to signify the action of which they were the spontaneous accompaniment. "Thus was language born from natural activity in view of supplying imperious needs, and the verb representing the action preceded all their words. The effort to procure the necessary and useful develops the reasoning powers, and tools soon became necessary. Wherever traces of prehistoric men are found, there is also to be found the flint implement. Thus reason, language, labor and implements, all manifestations

of an intelligence capable of progress, appeared almost simultaneously."

In another work, entitled Origin of Speech, Noiré has developed this hypothesis. His book was reviewed by Max Müller, who regarded this view as too exclusive, yet that it was far superior to either the onomatopœia or the interjection theory, and that it was certainly the best and most probable one brought forward at present.

Whether this hypothesis seems plausible or not, would not a comparative study of the physiology of the vocal organs, and of the connection between the brain and the faculty of speech throw light on this problem? May not the power of speech have been a differentiation of the musical power, and have originated from the play of the intenser emotions or passions rather than from the mechanical movements of the arms or legs in labor?

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RECENT LITERATURE.

THIRD ANNUAL REPORT OF THE U. S. GEOLOGICAL SURVEY.[1]—Succeeding the director's report and those of the chiefs of divisions, are the papers accompanying, and which constitute the main portion of the volume. These are: Birds with teeth, by Professor O. C. Marsh; The copper bearing rocks of Lake Superior, by R. S. Irving; Sketch of the geological history of Lake Lahontan, by Israel C. Russell; Abstract of the report on the geology of the Eureka district, Nevada, by Arnold Hague; Preliminary paper on the terminal moraine of the second glacial epoch, by T. C. Chamberlin; and a report of the non-marine fossil Mollusca of North America, by C. A. White, M.D.

All of these papers are carefully prepared and elaborately illustrated. In his article on birds with teeth, Professor Marsh concludes that the facts that these three oldest known birds should differ so widely from each other, points unmistakably to a great antiquity for the class. Archæopteryx, Hesperornis and Ichthyornis are all true birds; but the reptilian characters they possess are convergent toward a more generalized type. No Triassic birds are known, and hence we have no light on this stage of the development of the class. They will doubtless be found, however, and if we may judge from Jurassic mammals and reptiles, the next classes above and below birds, the avian forms of that period would still be birds, although with even stronger reptilian features. "For the primal forms of the bird-type, we must evidently look to the Palæozoic; and in the rich land-fauna of our American Permian we may yet hope to find the remains of both birds and mammals."

[1] *Third Annual Report of the U. S. Geological Survey to the Secretary of the Interior, 1881–'82.* By J. W. POWELL, Director. Washington, 1883. Royal 8vo, pp. 564.

Professor Marsh then enumerates the characters we should expect to find in the ancestral type of birds, the more essential characters being a free quadrate bone, since this is a universal feature in birds, and only partially retained in the Dinosaurs now known. "The birds would appear to have branched off by a single stem, which gradually lost the reptilian characters as it assumed the ornithic type, and in the existing Ratitæ we have the survivors of this direct line. The lineal descendants of this primal stock doubtless early attained feathers and warm blood, but, as already shown, never acquired the power of flight. The volant birds doubtless separated early from the main avian stem, probably in the Triassic, since, in the formation above, we have Archæopteryx with imperfect powers of flight."

In his sketch of the geological history of Lake Lahontan, Mr. Russell describes the topography of the Quaternary lake of that name which lay in what is now Northwestern Nevada, and is now represented by Pyramid and other lakes in Nevada, and Honey lake in California. This system of great lakes, as it seems to have been, was comparable in number and magnitude with the present lakes of the St. Lawrence basin. "At the time New England and a number of the Northern States were covered with an immense mer-de-glace, and the lofty peaks of the Rocky mountains, the Sierra Nevada and a few of the intermediate ranges gave birth to local glaciers, the ratio of precipitation to evaporation throughout the Great basin was so great as to give rise to a great number of lakes, whose combined surface must have formed a large per centage of the total area of the region. Twenty-one of these ancient lakes, of which Lake Bonneville and Lake Lahontan are the most interesting, have already been explored in the northern part of the basin, and at least three of some magnitude are known to have been in Prof. the south.

The tufa deposits of the lake basin are designated in the order of their age, lithoid, thinolithic and dendritic; these minerals are well represented in the plates. The tufa domes of Pyramid lake are well depicted in Pl. VII, which, with Pls. VIII and IX, were kindly loaned by the director of the survey. A general idea of the lake beds in the Humboldt valley is conveyed in Pl. IX. From the study of the terraces and tufa deposits of Lake Lahontan, it appears that the lake had two periods of high water, separated by a time when its basin was even more thoroughly desiccated than it is now, and followed by the present period of dryness. When the lake reached its second high-water stage it was inhabited by fresh-water gastropods and bivalves, and it must have attained a certain degree of freshness, but Mr. Russell adds, since modern lakes, such as Pyramid and Walker, with a degree of salinity distinctly perceptible to the taste, are now inhabited by similar gastropods, it is not necessary to assign to Lahontan, at that stage, a high degree of freshness.

PLATE VII.

Tufa Domes—Shore of Pyramid Lake.

Nearly all the valleys which combine to form the basin of Lake Lahontan are due to profound fractures, the displacements in numerous instances extending 4000 or 5000 feet. These movements are thought to be still in progress, the mountains throughout the Great basin either slowly rising or sinking. "As a matter of observation we find the evidence of recent faulting best defined along the bases of the highest of the ranges, indicating that these owe their distinction to the fact that they are still growing."

An important contribution to glacial geology is Thos. C. Chamberlin's preliminary account of the terminal moraine of the second geological epoch, illustrated by excellent maps and views. This second great terminal moraine marks a general advance of the great ice-sheet at a date considerably later than the stage of greatest glaciation. The great terminal moraines of the first glacial epoch have been traced from Cape Cod to Ohio and Illinois, but in the interior of the continent this "supposed extreme outer moraine has not been traced out." The author believes that the western portion of what was supposed to be the great terminal moraine of the first epoch is, in Michigan, Wisconsin, Minnesota and Iowa, a part of the later moraine.

HYATT ON THE GENERA OF FOSSIL CEPHALOPODS.—This is an elaborate discussion of the character and relations of the genera of fossil Cephalopods, the results of many years' patient study. It appears in the Proceedings of the Boston Society of Natural History, and is preliminary to a monograph which will appear in the Memoirs of the Museum of Comparative Zoölogy, at Cambridge, Mass.

Univalve shells, the author remarks, may be generally spoken of as cones, which may be either straight, curved or coiled. The larger number of the more ancient shelled cephalopods are straight cones. The young of nautilian shells are identical with the adults of the curved (arcuate) and coiled (gyroceran) and in different series repeat their forms, sutures, shell markings and the outlines of their whorl in transverse section. "They are in succession first arcuate, then gyroceran, and lastly nautilian or close-coiled. In several series genetic lines of adult forms may be followed, which lead by gradation from arcuate, cyrtoceran forms to close-coiled nautilian shells, the whole showing a connected series of transitions in the form and outline of section, sutures, structure and position of siphon, and shell ornaments and apertures. In some cases these graded series are in accord with the chronological record, the straight appearing first, the arcuate either in company with them or later in time, and the gyroceran and nautilian latest."

The author adds that we cannot of course claim that such perfect evidence has been found even in the larger number of series.

"In some of them, certainly, it is not an over-statement to say that the chronology of the evolution of form, the development of the individual, the gradations in the adults and the general differential characteristics all tell the same story, and are decisive for the opinion that in all the larger series of shell-bearing Cephalopoda, the nautilian shells belong to several distinct series and arose independently from straight cones through the intermedium of a graded series of arcuate and gyroceran or closely coiled forms. The generic terms, Cyrtoceras, Gyroceras and Nautilus are really only descriptive terms for the different stages in the development of an individual, and also the different stages in the development or evolution of the series of adult forms in time. In other words, each of these genera as now used, include representatives of all the different genetic series of Tetrabranchs, which are either young shells in the corresponding stage of growth, or adult shells in the corresponding stage of evolution."

Professor Hyatt maintains that the Nautilini were derived directly and independently from a straight cone, and that this primitive nautiline form was a close ally and ancestor of the straight orthoceran-like Bactrites of the Silurian. "All the remaining ammonoids are more concentrated in development, and skip the orthoceran, cyrtoceran and gyroceran stages of their evolution in time. They are evidently descendants of the close-coiled Nautilinidæ, and the evidence here is very strong that the whole order of Ammonoideaarose from a single organic center of distribution, the Nautilini of the Silurian. The succession in time, the evidence of gradation in structure and the development exactly accord with this statement. Nautilinidæ, Goniatites, Triassic transition forms of Ammonitinæ and the true Ammonites of the Jura form a perfect progessive series."

During the investigation Professor Hyatt has been able to add to the facts he has already brought forward in support of the law of acceleration, though he now prefers to designate it as "the law of concentration of development." All the more generalized or lower types, he says, have a direct mode of development, and the more specialized or complicated progressive types have, when at the acme of their development, a more indirect mode of development." The types which are descended from these last have often a mode of development which in many forms is an apparent return to the direct mode of development again."

It is impossible to farther epitomize this important paper, and we shall look forward with much interest to the complete illustrated memoir.

PARKER'S ZOÖTOMY.[1]—Undoubtedly a knowledge of animal morphology, or what used to be called comparative anatomy, lies at

[1] *A course of Instruction in Zoötomy* (*Vertebrata*). By T. JEFFEREY PARKER. With 74 illustrations. London, Macmillan & Co., 1884. 12mo, pp. 397. $2.25.

PLATE VIII.

Western face of the Moraine near Eagle, Wisconsin.

the basis of a genuine training in zoölogy, physiology or medicine; no one should undertake to be a systematic zoölogist, a physiologist or embryologist without a thorough knowledge of the anatomy of the leading types of the animal kingdom. The first step the student should take is to become familiar with the anatomy of a polyp, a worm, a mollusk, a crustacean, an insect, as well as a representative of each class of vertebrates. We should, as we are accustomed to with beginners, make this work comparative at the outset. We hear a great deal now-a-days of "animal morphology," we hear less of "comparative anatomy," we prefer the older and less pompous term, as the tendency to extreme specialization even in animal morphology is a dangerous one. Yet it does not appear to be so to the author of the present book. The forms he described are treated as if they were so many separate creations, and this is the only criticism we have to make on a work so carefully prepared and so well proportioned. The book is designed in great part to take the place of a teacher. Now to our mind no teacher who does not in the beginning excite his pupils after dissecting one animal thoroughly to compare it in its leading features with the members of other classes, can successfully teach morphology, whose value as a discipline consists in leading the student to compare as well as observe. A few additional pages of matter would, therefore, we think, have been of decided value in calling the student's attention to and fixing in his memory the facts concerning the resemblances as well as differences in the various types he may dissect. We think this may be done without the pupil's "losing in depth what he gains in breadth."

The list of animals selected and described in this course in zoötomy is as follows: the lamprey, skate, cod, lizard, pigeon and rabbit; if a frog, or better, a salamander, had been added, the list would have been complete, but this point has been covered by the full account of the frog in Huxley and Martin's Biology and Gage's account of the Necturus or mud puppy.

The introduction treats briefly of the tools and methods of preparing the subjects for dissection. The two most important chapters are those on the lamprey and lizard, as the pigeon has already been well described and figured in Rolleston's Forms of Animal Life; and the student can easily get access to accounts of the anatomy of a fish, while the works of Mivart and of Wilder on the cat, would be more useful to the American student than that of the rabbit in this book, however excellent Parker's description may be.

The plan of each chapter or section is excellent, the descriptions are well proportioned, the words to be emphasized are in heavy-faced type, the illustrations are well drawn and engraved, neatly lettered and fully explained. The lamprey is very difficult to dissect, and the species being the same on both continents, this

chapter will be particularly valuable to American students. The illustrations in this chapter are also very useful, the skull, with the "branchial basket" and anterior part of the notochord being shown together, besides cuts of the brain-case from above, a full page cut of the longitudinal section of a female from the left side, showing the organs in place; also a view of the urogenital sinus, with the rectum and part of the left kidney, with three transverse sections, one through the branchial region, another through the abdominal, and the third through the caudal; and finally a dorsal view of the brain.

The skate is a novel subject, and its anatomy is carefully described, the skeleton, venous system, urogenital organs, heart and blood-vessels, and nervous system including several views of the brain as well as the ear, being well illustrated. In like manner is the cod described and figured; this chapter will be useful to the American student; the cod's skull, disarticulated, is well figured and briefly described.

Fifty pages are devoted to the account of the lizard (*Lacerta agilis*), and this will be useful in the hands of the American student if living south of Pennsylvania, as he can readily obtain a Sceloporus or swift for dissection. The wood-cuts in this chapter represent the chondrocranium, the scales on the head of several species of lizards, the chief muscles of the ventral aspect and a general view of the body to show the alimentary, circulatory, respiratory and urogenital organs; the latter organs of each sex are also separately figured, as well as the heart and aortic arches, while the brain in different positions is well drawn and engraved. The remainder of the book, comprising the latter half, is devoted to the pigeon and rabbit.

With such a guide as this, and Rolleston's Forms of Life, Brooks' Invertebrate Anatomy, Huxley and Martin's Elementary Biology, Moale on the Turtle and Pigeon, with Parker and Bettany on the Skull, the beginner in zoötomy has full directions and every incentive to lay broad and deep foundations for a knowledge of comparative anatomy.

SHEPARD'S MINERAL RECORD.[1] — This is a bound series of blanks for the use of beginners in the study of minerals, and is preceded by excellent definitions of terms used in examining the physical characters, and of chemical reactions. The only criticisms we should make is, that reference is not made to the system of crystals or the special form, an important feature of instruction in mineralogy, though room is left blank for these points, which might be inserted by the instructor.

[1] *Systematic Mineral Record*, with a synopsis of terms and chemical reactions used in describing minerals. Prepared for instructors and students in mineralogy. By EDWARD M. SHEPARD, A.M., professor of biology and geology, Drury College, Springfield, Mo. Adapted to any mineralogy. A. S. Barnes & Co., New York and Chicago. Sm. 4'o, pp. 98.

PLATE IX.

Lahontan Lake-beds in Humboldt Valley.

Recent Books and Pamphlets.

Ingersoll, Ernest.—Country Cousins, short studies in the natural history of the United States. New York, 1884. From the author.

Cope, E. D.—Palæontological Bulletin, No. 39. Phila., 1884.

Clevenger, S. V.—Comparative physiology and psychology. Chicago, Jansen, McClurg & Co., 1885. From the publisher.

Hamlin, A. C.—Leisure hours among the gems. Boston, 1884. From the author.

Struthers, J.—On the bones, articulations and muscles of the rudimentary hind-limb of the Greenland right whale (*Balæna mysticetus*). Ext. Journ. Anat. and Physiol., 1881.

——On hereditary supra-condyloid process in man. Both from the author.

Loew, Oscar, and Bokorny, T.—Die chemische kraftquelle im lebenden protoplasma. Munchen, 1882. From the authors.

Dobson, G. E.—On the unimportance of the presence or absence of the hallux as a generic character in mammalogy.

——On the myology and visceral anatomy of *Capromys melanurus*, with a description of the species. Both from the Proc. Zoöl. Soc. London, 1884.

——On some peculiarities in the geographical distribution and in the habits of certain mammals inhabiting continental and oceanic islands.

——On the comparative variability of bones and muscles. Both read before the Biol. Section Brit. Assoc. Adv. Science, Montreal, 1884. All from the author.

Garrett, P. C.—Second report of the Committee on Lunacy of the Board of Public Charities, Penna., 1884. From the author.

Ennis, J.—Two great works to be done on our sidereal system. Washington, 1884. From the author.

Swan, C. H., Brooks, F., Herschel, C.—Ninth report of the Committee on the Metric System of Weights and Measures. Ext. Jour. Assoc. Eng. Societies, 1884.

Whitley, J. R.—The American Exhibition of the arts, inventions, manufactures, products and resources of the United States of America, London, 1886. From the author.

Lütken, C.—Des Crânes des autres ossements humans de Minas Geraes, decouvert et déterrés par le feu professeur P. W. Lund. From the author.

Reighard, J.—On the anatomy and histology of *Aulophorus vagus*. Ext. Proc. Amer. Acad. Arts and Sciences, 1884. From the author.

Winkler, T. C.—Geschiedenis van den Vleugetvinger overgedrukt vit het Album der Natur. From the author.

——Note sur une espèce de Rhamphorhynchus du Musée Teyler. Ext. Arch. du Mus. Teyler. Ser. II, quatrième partie. From the author.

Ext. United Service Oct. and Nov., 1884.—The late attacks upon the coast and geodetic survey. L. R. Hamersly & Co., 1884. From the publishers.

Gurley, W. F. E.—New Carboniferous fossils. Danville, Ill., 1883. From the author.

Folie, F.—Douze tables pour le calcul des réductions stellaires. Ext. Mem. de la Soc. Roy. des Sciences de Liege, 1883.

James, J. F.—The fucoids of the Cincinnati group. Ext. Jour. Cincin. Soc. Nat. Hist., Oct., 1884. From the author.

Powell, J. W.—Human evolution. Presid. address read before the Anthrop. Soc. of Washington, Nov. 6, 1883.

——Outlines of sociology. Idem, Feb., 1882.

——Outlines of the philosophy of the North American Indians. Read before Amer. Geog. Soc., Dec. 29, 1876.

——Address at inauguration of the Corcoran School of Science and Arts, Washington, D. C., Oct., 1884.

——The philosophic bearings of Darwinism. Read before the Biol. Soc. of Washington, May, 1882.

——Wyandotte government, a short study of tribal society. Read before sub-section anthropology. Amer. Assoc. Adv. Sci., Boston, 1880.

——Mythologic society. Read before Amer. Assoc. Adv. Science, Saratoga, Aug., 1879.

——The three methods of evolution. Presid. address before Philos. Soc. of Washington, Dec. 3, 1883.

Albrecht, P.—Sur les elements morphologiques du manubrium du sternum chez les mammifères.

——Erwiderung auf Herrn. Prof. Dr. Hermann v. Meyer's Aufsatz "Der Zwischen kiefer knocken und seine Beziehungen zur Hasenscharte und zur schrägen Gesichtsspalte."

——Ueber die Zahl der Zahne bei den Hasenscharten Kieferspalten.

——Ueber die morphologische Bedeutung der Kiefer-Lippen und Gesichtsspalten.

——Sur les Homodynamies que existent entre la main et le pied des mammiféres. All from the author.

Lewis, H. C.—On supposed glaciation in Pennsylvania south of the terminal moraine. Ext. Amer. Jour. of Science, 1884. From the author.

True, F. W.—Suggestions to the keepers of the U. S. life-saving stations, light-houses and light-ships relative to the best means of collecting and preserving specimens of whales and porpoises. From the author.

Richardson, Clifford.—An investigation of the composition of American wheat and corn. Dep. of Agriculture. Bulletin No. 4. From the author.

Wiley, H. W.—The Northern sugar industry during the season of 1883. Dep. of Agriculture. Bulletin No. 3. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

America.—*The Chilian Andes.*—The account sent by Dr. Paul Gussfeldt to the Berlin Academy of Sciences, of his recent journey in the Central Chilian Argentine Andes, contains so much that is new and strange that the American reader is led to wish that this continent could be made the scene of more thorough geographical exploration than has yet been accorded to it. It appears that the lofty mountain region containing Aconcagua, the loftiest known point in America, consists of a double range, separated, not by a wide basin or a well-defined valley, but by a trough-like depression, divided by cross ridges. The western chain is the true water-parting, and thus the eastern is broken through in many places by the water rising in the great trough between the two chains. This trough is about 185 miles long, is entirely uninhabited, and has a mean elevation of 9800 feet. The chief valleys of this region are called "cajones," or boxes, because of their straight walls of rock enclosing them. These valley sides are formed of boulder slopes and wall-like outcropping rock, and each has its separate vegetation-zone, limited by perpetual ice. The belts of vegetation, owing to the varied local influences, are of very irregular distribution, and for

[1] This department is edited by W. N. Lockington, Philadelphia.

the same reason the snow limit is not fixed. The diversity and richness of tint of soil and rock are material points in the landscape. The passes over these ranges reach heights of 11,394, 11,696, 12,270, 12,303, 13,474, and 13,779 feet. The highest elevations are on lateral spurs of the chief western chain, near Valle Hermoso, at the commencement of which rises the great volcano Aconcagua, 22,867 feet high.

The structure of the range, together with the wind, are unfavorable for the collection of large glacier-forming deposits of snow. The snow line is often broken by abrupt ice-streams wedged between masses of rock, but these glaciers end far above the valley bottom. The largest glacier found was at the head of a side-valley of the Cachapual, called the Cajon de los Cipreses. On this is an ice-fall 8530 feet long, with an average slope of 22° 15′. There is the evidence of glacier marks that the glaciation once reached a lower level than now (6299 feet); and Dr. Gussfeldt's companion pointed out a conspicuous red boulder, more than a mile away, as marking the point reached by the ice thirty years ago. On account of the abrupt crags, the high peaks seldom show a continuous snow-cap. The parallel ridges of snow caused by strong winds, melt under the fierce sun into forms which often simulate human figures, and are called "Penitentes." These are most abundant between 11,483 and 13,779 feet. The mean height of the snow line between 32° and 33° S. lat. is estimated at 13,779 feet, diminishing to 11,483 at 34° S. lat. Between the western cordillera and the Pacific there is an out-lying coast range. Dr. Gussfeldt and his assistant reached 21,030 feet on Aconcagua, and, though exhausted by the effort of speaking, had no flow of blood from mouth or nose.

The Supposed New Island off Iceland.—The supposed new island off Reykjanes, Iceland, turns out to be a myth. The French war-vessel *Romanche* and the Danish *Fylla* have carefully examined the locality without finding any new land. In the opinion of Capt. Normann, of the *Fylla*, one of the well-known Fowlskerries, either Geirfugladraugr or Grenadeerhuen, has figured as a new island. Possibly an abnormally clear day caused the lighthouse-keeper to, for the first time, perceive an object which he has since continued to see simply through knowing where to look for it.

Meade river.—Lieut. P. H. Ray has made an exploration southward from Point Barrow along the Meade river, which he struck sixty milesfrom its mouth, and followed for 100 miles, until he came in sight of a low range of mountains trending north-west and south-east, dividing the north-east water-shed from that of Kotzebue sound. The guides, fearful of imaginary enemies, refused to go further. The region is uninhabited, and is visited only by a few natives from Hornook and Ooglamie in pursuit of reindeer. There is no timber; a few Arctic willows on the river and

some coarse grass on the hummocks and along the seashore, and a dense growth of moss is all the vegetation. Lieut. Ray is satisfied that there is no open Polar sea from the fact that the temperature of the water does not alter between October and July, as it must do if a large body of warmer water existed round the pole.

Lake Mistassini.—Little that is definite appears to be as yet known respecting the actual dimensions of Lake Mistassini and other bodies of water reported to exist in the north-eastern part of the Province of Quebec and in Labrador. A French missionary, writing in 1672, says that Lake Mistassini is "believed to be so large that it took twenty days to walk around it." Mr. Burgess affirms that it is 150 miles in length, and abounds in deep bogs. An old trader of the "Compagnie des Postes du Roi," who was stationed on it for several years, estimated its least width at ninety miles. The account of 1672 mentions another lake "ten days round, and surrounded by lofty mountains." These lakesappear to occupy a depression similar to that occupied by Lakes St. John, Temiscaming, and many smaller lakes to the south ward, and Silurian limestone has been observed on Lake Mistassini as well as at Lake St. John. The former lake is supposed to be about 1300 feet above the sea, and the land between it and Lake St. John to the south of it, does not rise above 1500 feet, while Lake St. John is only 300 feet above the sea. The plain around Lake Mistassini is said to be very fertile. and attention has recently been called to the magnificent forests and fertile soil of the country around Hudson's bay, to the north of it. Three expeditions have been dispatched during the past summer to explore the lake region; one by way of Lake St. John, another by the River Betsiamits, and a third from Newfoundland. The last expedition has orders to land scientific observers at various points upon the coast of Labrador, where they will spend the winter. The vast plain stretching north and west of Lake St. John has a clayey soil of great fertility, and a climate equal to that of Montreal. Thousands of settlers are already there, and the dense forest is disappearing. The explorations in progress will doubtless open up extensive areas for colonization, besides adding largely to our geographical knowledge.

American Notes.—The articles found by an Eskimo upon a floe in Julianshaab bay appear to have been those left on the occasion when, according to the report of Messrs. Danenhower and Melville, the escaping crew of the *Jeanette* camped for a few days on some ice-floes. Among them are the lower part of a tent, the sides of a wooden chest, with some words in pencil written upon them, a bill of lading, a torn book of cheques, a pair of oil-skin trousers marked "Louis Noros," and a bear skin. The ice-floe must have drifted about 2500 miles, and as this occupied

about 1000 days, we have an average rate of drifting of two and a half nautical miles per day.——M. Thonar will undertake an expedition to investigate the delta of Pilcomayo, and endeavor to open up a great trade route between Bolivia and Paraguay. In this it is said that he will receive the active support of several South American governments.——Drs. Clauss and Herr von der Steinen have returned to Para from a successful investigation of the tributaries on the upper right bank of the Amazon and Xingu rivers.

AFRICA.—*Mr. O'Neill's Journey.*—Mr. H. E. O'Neill, in his account of his journey from Mozambique to Lakes Shirwa and Amaramba, through the Makua and Lomwe countries, states that in point of geographical interest, of security, and of facility of travel, this route compares favorably with any overland route to the African lakes. The Zanzibar-Tanganyika route is occupied by lawless chiefs, who levy extortionate black-mail, the route from North Nyassa to Zanzibar has been shown by the expedition of Capt. Elton to be one of great difficulty, and the old Kilwa-Nyassa route, opened up by Dr. Livingstone, now passes in great part through a deserted and desolate country, owing to the ravages of the Magwangwara, the same tribe which blocks the North Nyassa route. Native rule among the Makua consists of a confederation of petty chiefs, each of which is perfectly independent with regard to the internal affairs of his own state. The Makua can weave cloth, but wear so little that a palm's breadth, forty inches long, would provide clothing for half a dozen men or women. Namuli peak and its surrounding hills, 8500 to 9000 feet high, forms one of the most striking features of the country. A feeling of great reverence for particularly conspicuous hills, reaching almost to mountain-worship in the case of Namuli, exists among the Lomwe. The feeling probably arises from the fact that each of these elevations has served as a refuge to the people living near it when attacked by their enemies.

The Kwilu Expedition.—In human suffering and cost of life the expedition sent to H. M. Stanley, in 1882, to explore the Kwilu-Niadi valley, rivals that of Lieut. Greely to the Arctic. The party, consisting of seven Europeans and seventy Zanzibaris, got into difficulties from want of food at the start. Two Europeans were left behind at Isanghila, where one died. The accidental discharge of the rifle of a Zanzibari, soon after, nearly brought on a conflict with the natives. Two magnificent ranges of hills were then met with, separated by a lovely valley, watered by the Ludima, a tributary of the Niadi, which was found to be identical with the Kwilu. The first station of the association, Stephanieville, was founded near the junction of the Ludima with the Niadi. All the white men, except the leader, Capt. A. G. Elliott, were now disabled. Each of the two Belgian officers,

MM. Destrain and Legat, were left in charge of a station, yet Capt. Elliott pushed on, with Von Schaumann, hopelessly ill, lashed to a mule, and the only remaining officer in a deathly stupor from sun-stroke. Some time before this, a portion of the Zanzibaris mutinied, fourteen deserting, and part of the baggage had to be destroyed for want of bearers. Covered with painful ulcers, emaciated, and with bleeding feet, Capt. Elliott, when on the point of succumbing, was met by a native sent to his assistance by M. Van de Velde, who had been sent by Stanley to his assistance, and was at Kilabi, seven days off. Eventually Capt. Elliott and his two companions reached the coast, but Von Schauman died on the voyage home. In three and a half months only 600 miles had been traversed. Capt. Elliott subsequently explored the Kwliu river and valley in company with Mr. Spencer-Burns and MM. Mikie and Destrain. The district has for the most part been freely ceded by the natives to the association, and formed into a province with fifteen stations. Capt. Elliott is administrator, with a staff of twenty-eight officers and about 250 men.

African Notes.—Sr. Bianchi has successfully finished a journey from the eastern boundaries of Abyssinia along the River Golima to the Italian possession of Assab.——Lieut. Shufeldt, U. S. N., has recently traveled across Madagascar south-west from Antananarivo. He thoroughly investigated and mapped the head-waters of the Zizibongy and its tributaries, and reached the coast on July 2d, after a journey of 680 miles. Then crossing the Mozambique channel in an old boat, he landed at Mozambique.——Lieut. Becker will be despatched by the African International Association to cross Africa and connect Karema, on Lake Tanganyika, with Stanley's stations of the Upper Congo.——Herr R. Flegel has returned to Berlin. During the last two years he has explored all Adamawa, and discovered the course of the Binué, but the feuds and violence of the intervening tribes prevented him from journeying from the Binué to the Congo. His conviction is that the Binué is navigable for 1100 kilometers, and its chief affluents, as for instance the Taraba, for a distance of fifty to sixty nautical miles, during five or six months of the year.

South Georgia.—Though in 54° 31′ S. lat., this island is by its climate antarctic. Royal bay is surrounded with enormous glaciers 900 to 1200 feet in height, rising inland to 6000 or 7000 feet. The mean temperature during the year, from Sept., 1882, to Sept., 1883, was found by Dr. Schrader to be 35° F.; in February, the warmest month, it was 42°, in June, the coldest, 26° 6.′ The fauna and flora are meager, although the mosses are fine.

GEOLOGY AND PALÆONTOLOGY.

THE WHITE RIVER BEDS OF SWIFT CURRENT RIVER, NORTHWEST TERRITORY.—Dr. Geo. M. Dawson, of the Geological Survey of the Dominion of Canada, Dr. Alfred Selwyn, director, has sent me for identification a number of fragments of mammalian skeletons from the above locality for determination. They embrace ten species, which are the following: Rodentia, *Palæolagus turgidus* Cope; Creodonta, *Hemipsalodon grandis*, gen. et sp. nov.; Perissodactyla, *Menodus* sp., *Menodus* sp., *Anchitherium* sp. indet., *Aceratherium mite* Cope, *Aceratherium pumilum* sp. nov.; Artiodactyla, *Entelodon mortoni* Leidy, ? *Leptomeryx mammifer* sp. nov.; Carnivora, ? *Dinictis* sp.

Of the above the most remarkable is the Creodont, *Hemipsalodon grandis*. The new genus belongs to the Oxyænidæ,[1] and is the first one of that family that has been found in beds higher than the Bridger Eocene. The species is the largest of the Creodonta, and the jaw from which it is known is more robust than that of any existing carnivore. Its dimensions are about those of the *Achænodon insolens* of the Bridger beds. The genus Hemipsalodon differs from the others of the family in the presence in the lower jaw of the full dental series of four premolars and three true molars without diastema behind the canine. Incisors three. The only crown perfectly preserved is the last true molar. It is of the type of Oxyæna, but probably has no internal tubercle (specimen worn at the point). It has a heel more or less cutting. The species is characterized by the deep compressed form of the ramus, and the long symphysis. The incisor teeth are crowded, and the canine tooth is of enormous size, and is directed upwards. The premolars are all two-rooted, except the first. The fourth is longer than the first true molar. The true molars increase in size posteriorly. The third is very robust, and has elevated cusps, the median exceeding the anterior. The sectorial edges are very steep, forming together a V. The heel is quite short, and has a cutting keel which is the summit of the external face, and is nearly median. The coronoid process rises at a very short distance posterior to it. The masseteric fossa does not extend downwards to the inferior edge of the ramus. The latter is not inflected on the inner side as far posterior as below the middle of the coronoid process, where it is broken off.

Length of dental series, M. .212; of true molars .085; of premolars .108; diameters of last true molar: anteroposterior .034, transverse .021; do. of canine at base: anteroposterior .040, transverse .029. Depth of ramus at M.3, .086; length of symphysis .131.—*E. D. Cope.*

OCCURRENCE OF BOULDERS OF DECOMPOSITION AT WASHINGTON, D. C., AND ELSEWHERE.—In the literature of surface geology surprisingly little is said of "boulders of decomposition." This

[1] See NATURALIST, 1884, p. 480.

probably arises from the fact that such are seldom seen *in situ* north of the southern limit of the drift, having been removed from their places of origin during the ice age. It may not be uninteresting to those geologists whose studies are in the field of surface deposits to know of a convenient locality where such boulders are even in the process of being made, as doubtless very many of the erratics, especially those of larger size, were thus produced before their subsequent transportation, as pointed out by Dr. Sterry Hunt and others.

At several localities in the District of Columbia, boulders of various sizes can be seen, which to the superficial observer may be taken for drift masses, as in my own case upon earlier visits to the region. During June, 1884, whilst driving with Mr. W. J. McGee (U. S. Geol. Surv.) past a hillside just outside of Georgetown, along the Potomac river, I observed perfectly rounded boulders of gneiss in a large mass of decayed rock of similar composition. Subsequently, accompanied by Mr. George P. Merrill (National Museum), we more thoroughly examined them. The hillside has been partly cut away in the construction of the road beside the river, and thus the decayed crystalline rocks are exposed for a depth of forty or fifty feet or more. Much of the gneiss rock is disintegrated, but contains unaltered masses which have resisted the atmospheric decay. The rock is often poor in feldspar. In some places it is hornblendic. Some of the gneiss upon weathering exhibits a schistose structure, yet much is remarkably compact, but traversed by numerous jointed planes, extending in all directions. As the weathering proceeds from the jointed planes it leaves solid masses of every possible shape, from those with only the more exposed upper solid angles rounded off, through various forms where all the angles are removed, but with flat sides remaining, representing the original joint planes, to masses which are almost perfectly spheroidal, though often showing a banded structure. Internally some of the smaller boulders are more or less decayed, others are perfectly compact, but in digging them out there may be seen surrounding them concentric zones, marking not concretionary structure but the progress of decay. These coatings may be removed like the coats of an onion. Each zone is defined more or less sharply, sometimes with comparatively little gradation from the last decomposed layer to the resulting solid interior which forms the boulder.

Upon the sloping top of the hills there are large sized boulders; with their angles and faces more or less rounded, and although standing two, three or four feet above the grass-covered soil of decomposed gneiss, yet their under portions, upon examination, are found to be connected with the solid masses beneath. Thus we find in every stage of production excellent examples of the genesis of large "boulders of decomposition"—boulders not distinguishable from very many of those which have been trans-

ported great distances during the Pleistocene period. There are several localities in the District of Columbia where such boulders may be seen, but their development cannot be studied so well as in the artificial cuttings in the hillsides along the Potomac river.

Having made a study of these large boulders in a state of formation, one, who is familiar with Northern erratics, is led to agree with Dr. Sterry Hunt, that at least the larger "rounded masses of crystalline rocks, left in the process of decay, constitute the boulders of the drift," and not only these but many *roches moutonnées.*

This deduction has been objected to upon the ground that boulders generally do not continue to enfoliate.

In the District of Columbia many of the boulders seen out of the hillsides described, do not show continued exfoliation (naturally very slow and with the atmospheric forces removing such as rapidly as formed, where not protected) any more than many erratics, while others are more or less uniformly decayed throughout the whole mass.

Although very many erratics do not show regular exfoliation, yet there are numbers of places where exfoliating boulders may be found in the drift. Perhaps there are no better localities for studying these rocks than those I examined during the last two summers, in the greater drift deposits along the Mississippi river, at Burlington, Keokuk, Warsaw and elsewhere. At these places numerous northern boulders—mostly greenstones—may be found of various sizes from a few pounds to a few thousand, which are now exfoliating and in various stages of decay, having forms from subangular to spheroidal. Also near the southern limit of the drift, at Columbia, Mo., situated upon the highlands, away from the river valleys, similar examples may be found, both of greenstone and gneissoid rocks.

Neither the presence nor absence of ice scratches affect the above explanation of the primary origin of these large boulders, but only represent subsequent abrasion, or the absence of that action, or else the more recent surface decay of the rocks themselves.—*J. W. Spencer, M.A., Ph.D., F.G.S.*

ARE THERE ANY FOSSIL ALGÆ?—Mr. Lester F. Ward, in a paper read before the American Association at Philadelphia gave some statistics of the fossil flora of the globe. Among other things he said that from the Lower Silurian there have been described species of Algæ. The question arises, what are the probabilities of Algæ being preserved in a fossil state?

It seems to have been the habit of geologists, almost from the time that palæontology assumed the aspect of a science, to refer to "fucoids" or Algæ many fossil markings which were evidently not *animal* remains. It was assumed that everything fossil must have been an organism, and it is only of late years

that the fact has been admitted that many of these fucoids are in reality inorganic.

Let any one consider for a moment the structure of the most of the species of modern Algæ; remember how easy it is for cellular tissue to be destroyed by only a short immersion in water, and the unreasonableness of expecting to find fossil Algæ will be perceived. Or again, let anyone turn, as Professor Lesquereux, for one, has done, to modern sea beaches; let him see the immense masses of kelp thrown up by the waves of every storm, and see how soon they disappear by passing "into gelatinous, half-fluid matter, which penetrates the sand" (Lesq.), and he will again see how unreasonable it is to say Algæ can be long preserved. Even when covered with sand, mud or clay they disappear and leave no trace behind them.

Professor Hall, in the first two volumes of the Palæontology of New York, enumerates thirty-six species and varieties of these fucoids from the Trenton, Hudson River and Clinton groups. He recognizes the fact that many trails, burrows and possible water marks are preserved in the rocks, but has no hesitation in referring many fossil marks to undoubted Algæ. Later writers have not been behind in naming and describing other species. In 1878 fourteen new ones were added as found in the rocks of the Cincinnati group. Recent investigations of these fourteen, and of some eighteen others reported from this group, have revealed the fact that *not a single one* is an undoubted Algæ, *all* can be referred either to water marks, trails, tracks or burrows of different sorts, or to graptolites.

This statement can be proved only by comparison with marks found on recent beaches and mud flats. Sir Charles Lyell has shown how leaves, impressions of bird tracks, mud cracks, worm borings and rain-drop impressions can be and are preserved on the mud flats of the Bay of Fundy. There is no reason for supposing that circumstances were less favorable during the continuance of the Silurian epoch in geological time. The writer of this has studied many recent mud marks, and has seen in process of formation tracks and burrows which resemble, to an astonishing degree these fossil marks.

For instance, the burrows made by a species of beetle in the mud wonderfully resemble some of the fossils, *Palæophycus rugosus*, for example. The trickling of water down a sloping bank leaves traces like those which, fossil, have been called Algæ. The dashing of rain on the surface of mud leaves marks which have been compared to the roots of plants. Impressions left on mud by fragments of organisms have been described as fossil Algæ, even when not the remotest resemblance could be noted between them and any modern prototype.

Professor Nathorst, in a memoir written in Swedish[1] and pub-

[1]Om spar af nagra Evertebrerade djur M. M. ochderas Paleontologsika Betydelse.

lished in Stockholm in 1881, enters a vigorous protest against the indiscriminate identification of fossil marks with Algæ. In this memoir he tells how certain of these marks were readily made by himself, and how many others can be identified with marks seen on ocean beaches.[1] It is, indeed, time that this habit of referring to some sort of life every mark found in the rocks of the earth, and calling all uncertain marks marine plants, should be protested against. If it is not done the nomenclature of the science will be so encumbered with useless names that chaos will result. The multiplication of species has gone entirely too far already; and when every mark made by a dash of water, every turn made by a worm or shell, and every print left by the claw of a crustacean is described as a new addition to science, it is time to call a halt and eliminate some of the old before making any more new species.—*Jos. F. James.*

GEOLOGICAL NEWS.—*Jurassic.*—The Marquis of Saporta announced to the geological section of the French Association for the Advancement of Science, the discovery of a plant bed of Jurassic age near Beaune. The enclosing rock is a fine-grained limestone, probably of the Corallian epoch. The plants are closely related to those which have been collected from beds of the same age upon the Meuse, and consist of attenuated conifers and dwarf cycads and ferns. The discovery at two points so far apart of such a starveling flora proves that it was not local, as at first believed, but was spread over a large area. Associated with these plants are some widely-spread echini, such as *Cidaris cervicalis*, *C. florigemma*, etc. M. Saporta has also returned to the defense of bilobites, gyrolites and other fossils, the vegetable origin of which has recently been disputed.——The Cretaceous of the Pyrenees has been studied by M. Hebert, who published the first part of his researches in 1867, and in a more recent article states that nothing has since come to hand to invalidate his previous conclusions respecting the Lower Cretaceous, which are to the effect that the Lower Neocomian is wanting, the Middle Neocomian is continuous, the Upper Neocomian occurs at many points, and is lacking in others through denudation, and that the Gault exists both in the Central Pyrenees and the Corbières. The Lower Cretaceous usually abuts upon faults which bring it in contact with beds which are proved by their fauna to be Senonian, and therefore much more recent. The Lower Cenomanian appears to be absent from this region, while the Upper Cenomanian lies either upon the Neocomian or the Trias, thus showing that at the time when the chalk of Rouen was deposited the Pyrenees had in great part emerged, forming an island or a series of islets in a Cenomanian sea. The Turonian is largely represented in the Pyrenees, but the almost crystalline structure of the beds is unfavora ble to palæontological researches.

[1] The Count Saporta has shown, in reply to Mr. Nathorst, that some of the reported Algæ are correctly so determined.—ED.

Tertiary.—Sr. Lotti (Boll. Com. Geol. d'Italia, 1884) gives a summary of his investigations into the age and structure of the granites of Elba and the surrounding districts. These granites show two principal types, granite and quartzose porphyry; the latter traverses and is involved with the sedimentary rocks of the Apennines in such a way that geologists have been compelled to pronounce it Eocene. As it is against the usual idea to refer granites to so recent an epoch, an effort has been made to find a separation between the granite and the quartzose porphyry into which it passes. This Sr. Lotti declares to be thoroughly inadmissible, and at direct issue with the facts. The feldspathic rocks graduate from a normal or tourmaliferous granite to a quartzose porphyry through varieties with or without tourmaline, but the Pre-silurian gneissic schists of the eastern part of the Elba show a gradual passage toward granite, and are traversed by granite seams. Sr. Lotti concludes that not only are the porphyry, granite and intermediate varieties of the same age, but that all were formed at the expense of the gneissic schists in the Eocene epoch, while the Eocene strata were contorted and dislocated, and fragments embedded in the erupted mass.

Quaternary.—M. A. Favre has presented the Paris Academy of Sciences with a map of the ancient glaciers of the northern slope of the Swiss Alps and of the chain of Mt. Blanc. This map indicates the development of the glaciers, and, so far as the scale permits, shows also the glacial deposits, erratic blocks, and moraines. Besides showing the direction and extension of the seven principal glaciers, M. Favre demonstrates how, on taking the height of an erratic block above the neighboring valley, it is possible to know what was formerly the thickness of the ice over that point, and also how the slope of the surface of the ancient glacier can be determined. In this way he has determined thicknesses of 1181, 1220 and 1235 meters. The author particularly insists upon the extension of the glacier of the Rhone, which at certain points reaches a height of 1650 meters, and for a length of 149 kilometers and a width of 45 was almost horizontal. The moraines of these old glaciers are numerous. Many are composed of clayey or marly deposits with striated pebbles and blocks of greater or less size, while others are almost entirely formed of blocks of crystalline rocks. Examples of the latter occur at Combloux and Césarege, in the valleys of the Arve, Rhone, etc. Here are blocks which contain from 700 to even 2000 cubic meters.

BOTANY.[1]

THE FERTILIZATION OF PHYSOSTEGIA VIRGINIANA.—In marked contrast with the imperfectly proterandrous almost synacmic *Brunella vulgaris* is the closely related Physostegia. The pro-

[1] Edited by PROF. C. E. BESSEY, Lincoln, Nebraska.

terandry and movements of filaments and styles are here decided. On the opening of the bud the almost equal anthers converge and place themselves in line across the throat of the flower. The stamens curve forward so as to come into more ready contact with the body of the visiting bee (Fig. 1), while the style is curved backward and lies under the upper lip of the corolla. When the stamens become effete the pairs on either side diverge (Fig. 2) and bend back, stationing themselves under the upper lip while the style moves forwards, takes the place of the effete stamens and opens its bilobed stigma (Fig. 3). Such is the proterandry of this flower which, as most of its allies, requires the visits of bees for its fertilization.

The flower is of a pale rose color, which is deeper on the upper lip. The upper and lower lips are spotted with purple, while the

Fig. 1. Fig. 2. Fig. 3.

Physostegia virginiana. FIG. 1.—Male state. Fig. 2.—Stamens curved back. FIG. 3.—Female state; *a*, anthers; *st*, stigmas.

interior of the inflated corolla is striped with the same color, the lines leading downwards and backwards towards the stamens, the filaments serving as guides to the honey, which lies in a tube formed by the contraction of the corolla along the line of the outer set of filaments. In this way two tubes are formed, an upper and larger one, which is convenient for the bees, and a lower contracted one which appears more accessible at first sight, but contracts below, so as to doom to disappointment the mistaken insect. The lines of purple lead to the true entrance. In this species, as in the Brunella, the honey gland seems to be a body of greenish-yellow color, occupying the place of a fifth nutlet supposing that the flower contained that many.— *Aug. F. Foerste, Granville, Ohio.*

BEGINNING BOTANY.—In teaching botany during the past twelve or fifteen years, I have generally set students at work for several weeks, in the beginning, with specimens only. These are given each member, and he is required to investigate and report at the meeting of the class. Some of these reports are made in writing. More or less of this work is done throughout the course. It has proved very satisfactory to pupil and teacher.

In March, before the opening of vegetation, the last class of freshmen began with the study of young branches of numerous kinds of deciduous and evergreen trees and shrubs. I send you the notes of W. F. Hoyt, one member of the class. I do not know that they are any better than many others which were presented:

"A comparison of the leaves, buds and young branches of the Scotch pine with those of the Austrian pine.

"To a casual observer there is little difference between these two pines, but on close inspection it will be noticed that the Austrian bears a medium-sized cone, while the Scotch has a very small one, grown sparingly. [It was not intended to study cones at this time.]

"Again, the leaves of the Austrian pine are from five to five and a-half inches long. They are thick and stiff, while those of the Scotch pine are from two to three and a-half inches long, and are quite slender and limber. In both the leaves have the same shape; in both the leaves are in pairs, and when placed together make a long round body. The covering of the lower part of the leaves extends much farther up on the Austrian, and is of a much darker color than on the Scotch pine. The leaves of the Scotch pine are lighter in color; the tree and branches more slender.

"The outer bark of the Austrian is thicker and darker, and the primary leaf scales shows very plainly. The leaf scales do not show plainly in the Scotch pine. Both have three layers of bark, the outer being tough and thin, the next dark-green and spongy, the inner white; in the Austrian quite tender; in the Scotch tougher and more compact.

"As a general rule the Scotch pine sends out five branches in a whorl, while the Austrian pines show no such regularity in this respect. On cutting the limb the Scotch pine discharges more pitch than is discharged by the Austrian pine. The wood of the Scotch pine is a little lighter in color, the rings more plainly marked and the pith a little larger."

In a comparison of the twigs of butternut with those of the pepperidge, A. E. Hager observed, among other things, that the pith of pepperidge contained numerous hard transparent partitions. Our text-books all tell us of the cavities in the pith of butternut.

Work done later in the course was better done.—*W. J. Beal. Lansing, Mich.*

The Study of Parasitic Fungi.—One of the hopeful signs of the times, so far as botany is concerned, is the increasing interest taken in the study of the lower plants in this country. The Fungi and the minute forms of Algæ have been too long neglected excepting by a few lonely specialists here and there who quietly worked away, while almost entirely ignored by the mass of botanists and collectors. Now, however, the eyes of collectors,

while not less open to the higher plants, are learning to look for plants of all kinds, from the simplest protophytes to the most conspicuous of phanerogams. We may hope some day to see a manual of botany which will include within its covers descriptions of all the species of the region it covers.

The Preliminary List of the Parasitic Fungi of Wisconsin, by Professor Trelease, must prove a considerable aid and strong incentive to the collection of Fungi in Wisconsin. About 270 species are recorded, a large list when we remember that it is confined to the parasitic forms only. Most of the species were collected about Madison by the author, and all, with but "one or two exceptions," are preserved as herbarium specimens. Throughout the list hosts and localities are given, and in many cases these are accompanied by valuable critical notes, indicating thorough and careful work.

The Peronosporeæ of the list number twenty-five species, of which four belong to the genus Cystopus, one to Phytophthora and twenty to Peronospora. The Perisporiaceæ number twenty species, the Uredineæ sixty-five (not counting isolated Uredo and æcidial forms, seven of the former and twenty-seven of the latter) and the Ustilagineæ twenty-two species.—*C. E. Bessey.*

Variation in Cultivated Plants.—If seed of the various sorts of the cabbage family be planted alongside each other, a resemblance is observed between all the seedlings at a certain date; it is only as growth proceeds that the development begins to differentiate differences. It seems probable, through a study of the law of breeding, that the period of divergence marks the period at which original selection commenced in order to obtain our present forms. If this observation be substantiated, then by careful study of seedling development we shall be able to determine points of departure at which human guidance shall be enabled to direct in line with the tendencies of the plant. This study of plant growth after the method used in zoölogy, the study of embryology so to speak, not the term "embryology" as applied to nature's plant but that of man's plant, the period between the seed and the differentiation from the natural type, offers much promise of good results, and it seems quite probable that as we attempt to influence the development of the plant before or at the time of the differentiation into the acquired properties of the mature plant we can initiate a new series of selections in certain varieties whose root, bulb, stem and foliage finds use.—*E. L. Sturtevant in 2d Ann. Rept. N. Y. Agrl. Expr. Station.*

Botanical Notes. — The post-graduate course of study in botany offered by Syracuse University is significant of changed notions as to what advanced work in botany consists of. The course is two years in length and includes vegetable histology, physiology, the study of phanerogams, pteridophytes, mosses,

liverworts, lichens, algæ and fungi. Collections are required in each group, thus insuring a practical acquaintance with the plants in their native habitats.——In the first annual report of the Wisconsin Agricultural Experiment Station, Professor Trelease gives accurate popular descriptions of the onion mold (*Peronospora schleideniana* D. By.) and the apple scab and leaf blight (*Fusicladium dendriticum* Wallroth). Both articles are illustrated by wood-cuts, which add materially to their value. Work of this kind is, in our opinion, much more valuable than that which usually fills the reports of these stations. We wish we could see more papers like Professor Trelease's. May we not commend to the directors of agricultural stations the remark of the editor of *Science* in a recent number of that journal, in discussing the proper aim and scope of such stations: "The great need of agriculture to-day is not new varieties of plants or improved breeds of animals, new methods of cultivating the soil or improved systems of farming; all these, and many other like things, are good; but the two great wants are a better knowledge of principles and greater intelligence to apply them."——Dr. B. D. Halsted, of New York, has been elected to the chair of botany in the Iowa Agricultural College.——The December *Journal of Botany* contains a fine photograph of the late George Bentham.——We see it announced in English journals that translations of De Candolle's Origin of Cultivated Plants, and De Bary's Anatomy of the Vegetative Organs of the Phanerogams and Ferns have recently been brought out, the former by C. Keagan Paul, London, and the latter by the Clarendon Press, Oxford. ——De Bary's "Vergleichende Morphologie und Biologie der Pilze, Mycetozoen und Bacterien has just reached us, but too late for further notice at this time. It is a stout volume of 558 octavo pages and is illustrated with 198 wood-cuts. This work merits an early translation.——*The Journal of Mycology*, by J. B. Ellis and W. A. Kellerman is announced to appear soon.

ENTOMOLOGY.

Embryology of Aphides.[1]—Witlaczil corrects many misconceptions and adds largely to our knowledge of insect embryology. His researches were chiefly on the viviparous females. The oviparous females and the males appear late in season, and have much the same course of development as is here described. The winter-eggs are specially characterized by a large amount of yolk.

1. *The Egg.*—The egg has a peripheral part consisting of clear protoplasm, and a central part consisting chiefly of granulated yolk. The germinal vesicle with nucleus is in the central part, and is capable of amœboid movements. The anterior and poste-

[1] By Dr. Emanuel Witlaczil, of Vienna (Zeitschrift f. Wiss. Zool., Bd. XL, 1884, p. 559–696, and taf. XXVIII–XXXIV).

rior poles of the egg are determined by its position in the ovarian tubule, in which it remains during its whole course of development.

2. *Segmentation and formation of Blastoderm.*—The segmentation instead of being superficial, as usually described, is *endovitelline*. The germinal sac dissolves, and its nucleus divides repeatedly, forming a large number of nuclei within the yolk. The nuclei have amœboid movements, and go towards the posterior pole (*PP*),[1] and thence spread over the surface-protoplasm. A few of the nuclei remain in the center; but the great majority become distributed over the surface, where each forms a center of attraction for the protoplasm. Thus a layer of cells is formed over the whole surface, the cells being smaller and more numerous towards the posterior pole, which is most active in its rate of development (Fig. 1). This layer is the blastoderm. A few cells are subsequently formed by the nuclei remaining in the center, but the protoplasm in the center being scanty, the rate of development is retarded or partially suppressed.

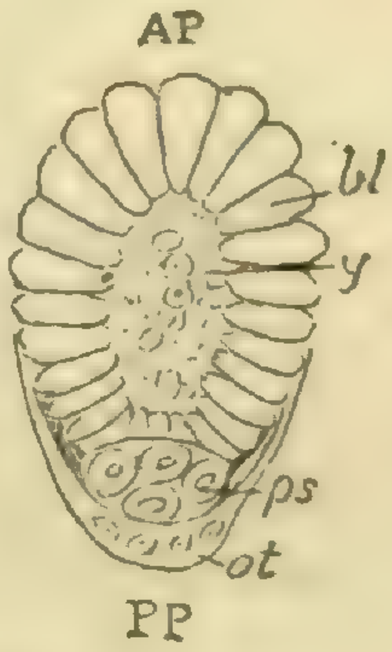


Fig. 1.

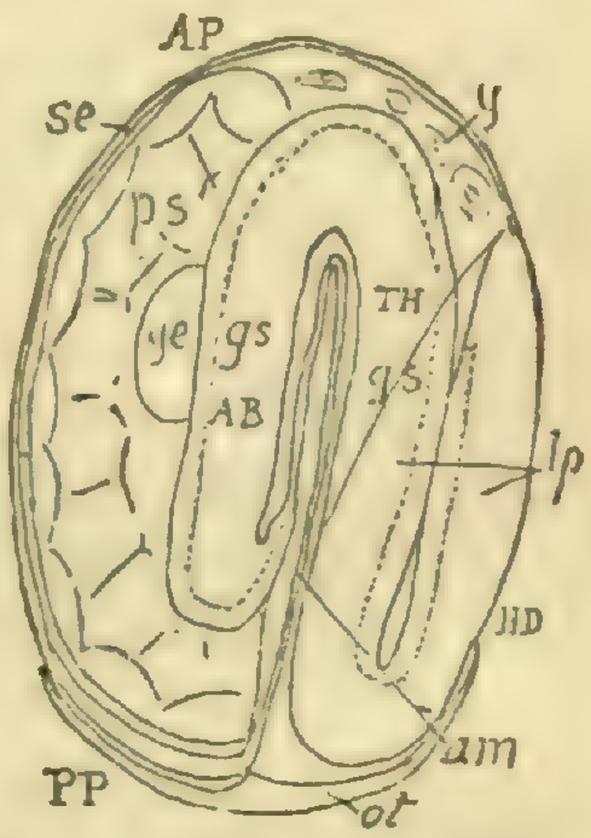


Fig. 2.

FIG. 1.—Ovum with blastoderm completed and pseudovitellus beginning to invaginate. FIG. 2.—Germ-streak, lateral plates and amnion are completed; yolk becoming exhausted; pseudovitellus enclosing genital layer and part of germ-streak. The dotted line indicates the commencing mesoblast.

This mode of development is a kind of gastrulation, showing a transition to epiboly, in which the peripheric protoplasm would be confined to the spot over the germinal sac. The largeness of the egg and the distribution of protoplasm all over the surface, cause the difference. The few cells formed in the center represent the endoderm.

3. *Peculiar to Aphides.*—Cells from the epithelium of the ovarian tube form an appendage to the posterior pole of the egg. A single cell is given off from these, which repeatedly divides so as to become a cell-mass. These increase by absorbing food, and afterwards became invaginated as a greenish mass, called *pseudovitellus* (*ps*). This is destined to be received dorsally into the embryo and to become paired masses in the abdomen. The

[1] Explanation of reference letters in the figures; *AB*, abdomen; *AP*, anterior pole; *HD*, head; *PP*, posterior pole; *TH*, thorax; *am*, amnion; *at*, antennæ; *bl*, blastoderm; *br*, brain; *ec*, ectoderm; *ge*, generative cells; *gs*, germ-streak; *lp*, lateral plate; *md*, mandible; mx^1 mx^2, first and second maxillæ; *ot*, ovarian tube-cells; p^1 p^2 p^3, first, second and third thoracic limbs; *pc*, procephalic part; *prc*, proctodæum; *ps*, pseudovitellus; *se*, serous layer; *sg*, salivary glands; *st*, stomodæum; *y*, yolk.

inside of the ovarian-tube cells (*ot*) remain as an appendage to the posterior pole of the egg.

4. *Formation of Germ-streak.*—Energetic cell multiplication at the posterior pole causes a new invagination at that place (Fig. 2). One side of the invaginated part is of thick cells, this is the *germ-streak* (*gs*) (ventral plate of Balfour), and ultimately the embryo; the other side of the invaginated part is of thin cells, this becomes the amnion (*am*). The blastoderm remains thin, except where it adjoins the outer extremity of the germ-streak, where it is thickened so as to form lateral plates (*lp*). Thus embryo and amnion are both buried in the center of the egg; the embryo bends ventrally, the abdomen curving round so as to approximate to the posterior pole, and to have appendages and amnion within its bend. The head end is at the place of invagination, lateral plates coöperating with the extremity of the germ-streak towards the formation of head and brain.

The central position of the embryo is characteristic of the lower orders of insects, which are therefore termed *entoblastic*. These include Hemiptera, Orthoptera and probably Thysanura. The higher orders, as Hymenoptera, Lepidoptera, Coleoptera, Diptera and perhaps Neuroptera, are *ectoblastic*, having a ventral plate formed on the surface, afterwards sinking slightly under the blastoderm, and having the anterior pole of the egg the more active. The ectoblastic condition seems to be a case of anticipation of changes which must afterwards be encountered by the inferior forms (see section 14 below).

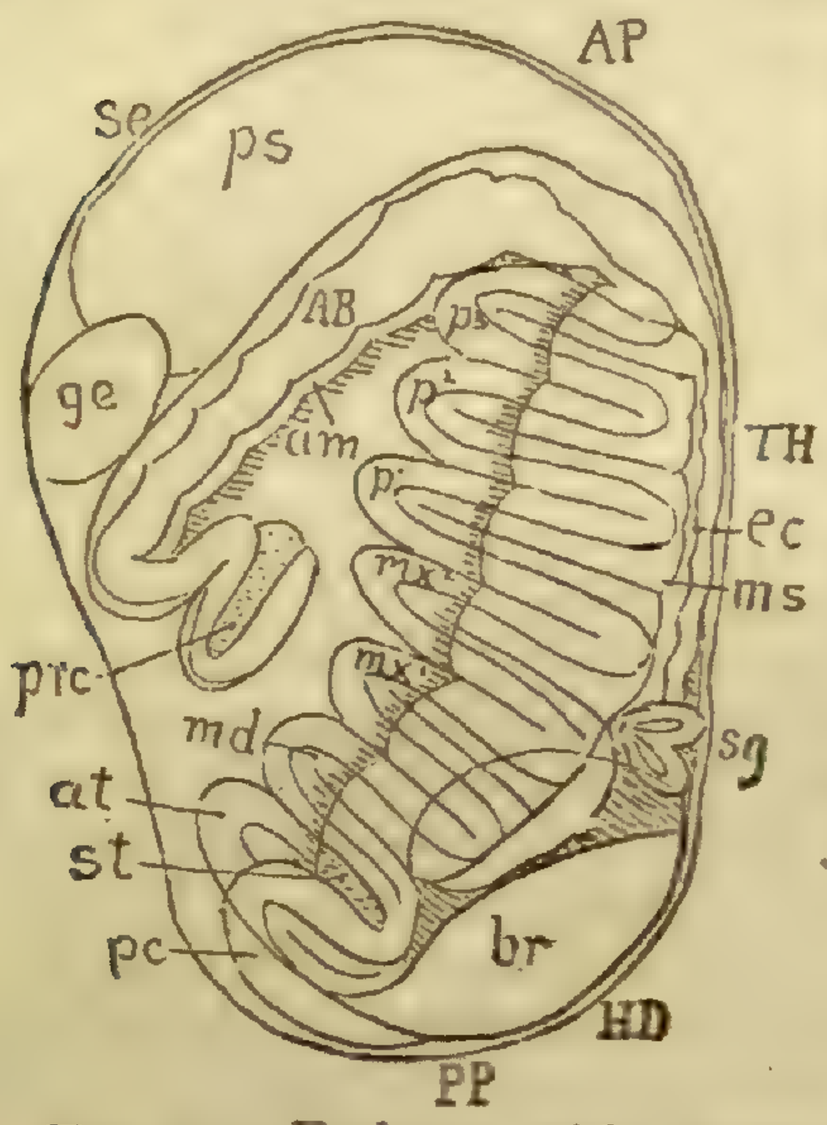


FIG. 3.—Embryo with appendages formed, before its revolution in the egg.

5. The blastoderm being now thin becomes the *serous tunic* around the whole egg.

6. *Genital Cells.*—A few large cells arise at an early stage inside the blastoderm, near the place of invagination (*ge*). These come to be ultimately received into the embryo along with the pseudo-vitellus, and become paired generative organs, groups of ovarian tubules.

7. *Germinal Layers.*—The germ-streak divides into an outer and an inner layer, each cell dividing into an outer and inner part. Thus are formed *ectoderm* and *mesoderm* (*ec*, *ms* in Fig. 3; also indicated by the dotted line in Fig. 2). The few cells formed in the center of the egg are the only representatives of endoderm. (In ectoblastic insects the mesoblast is formed by an infolding of ectoderm.)

8. The *appendages* next show themselves, those of the head

arising first; and the body becomes segmented, the head having three (afterwards four) segments; the thorax three and the abdomen seven or eight (afterwards ten, including the telson). Thus seventeen would be the maximum number of somites of the insects.

9. *Alimentary Canal.*—An invagination for the mouth is seen (*stomodæum, st*), and subsequently another for the anus and intestine (*proctodæum, prc*). These meet each other in the body so as to complete the alimentary canal. The stomodæum forms œsophagus and stomach; proctodæum forms intestine and rectum. The mid-intestine is not chitinized, but this is related to its function and has no embryological significancy.

The true endoderm becomes yolk-balls, afterwards wandering cells, subserving nutrition, but not directly aiding in the formation of the alimentary canal or of any other organ. The author excludes the endoderm from any share in forming the intestine in all Arthropods, if not more widely.

10. The *appendages* now shew their special characters. They arise by an evagination of the body wall, including ectoderm, mesoderm and part of the body cavity. Thus arise the mandibles and two pairs of maxillæ in the head; these keep small as compared with the limbs; the mandibles and first maxillæ afterwards combine to form a retort-like mass. The antennæ arise beside the stomodæum, in the same way as the other appendages (not from the procephalic part). The abdominal segments bear minute projections, probably rudimentary limbs.

11. The *procephalic part* is not originally lobed in Aphides; it arises as an extension forwards of the antennal segment. It subsequently becomes pointed and forms the labrum.

12. The *ventral nerve-cord* arises from the ectoderm, its cells dividing so as to leave only a thin dermal layer. Transverse segmentation causes it to be marked off into ganglia (three anal, three thoracic, seven abdominal, which are small). These subsequently coalesce into a subœsophageal and ventral mass.

The *brain* is formed in the region of the lateral plates, but its primitive relation to the ventral cord was not made out.

13. *Body-cavity.*—The general body-cavity represents the original segmentation-cavity. In an early stage free polar-cavities are formed between blastoderm and yolk, thus corresponding to the segmentation-cavity of lower animals. These cavities uniting insert themselves between the yolk and germ-streak, and extend into the embryo and its appendages. The same cavity spreads under the serous layer as a separate cavity. In the early stages the embryo is open dorsally, and by this route the pseudo-vitellus and generative mass find admission to its interior. Between the embryo and amnion is an "embryonal cavity" derived from the lumen of the ovarian tube.

14. *Revolution of Embryo.*—When the parts of the body and

the appendages are well formed (after the stage indicated in Fig. 3) the whole embryo changes its position in the egg, so as to approach the original attitude of the ectoblastic embryos. The abdomen is shifted away from its proximity to the head and thorax. The head moves to the anterior pole; the abdomen to the posterior pole; the curvature of the embryo becomes changed so as to invert the relation of dorsal and ventral aspects.

15. *Tracheæ.*—Seven pairs of minute invaginations appear on the sides of the abdomen, and afterwards two pairs in the thorax (sometimes a third in the thorax and an eighth in the abdomen, giving a maximum of eleven pairs). These are the entrances of the tracheæ whose inner extremities are afterwards united by longitudinal tracheæ. The salivary ducts from the third postoral segment to the salivary glands (*sg*) arise in a similar way, and seem to be homologous with tracheæ.

16. The *heart* is formed as a solid cylinder of mesoblast in the dorsal region. It afterwards becomes hollow, the central cells probably becoming blood corpuscles; is constricted at intervals and obtains alary muscles and valves.

17. *Cornicula.*—The "sugar-tubes," or cornicula, have no sugar or honey, but urates, which are discharged from secreting cells within. They arise as thickenings of the abdominal walls. It is not the honey but the excrement of Aphides that ants seek after. There are no malpighian vessels in Aphis, their function being perhaps vicariously discharged by the cornicula.

18. The wings arise by evaginations of the dermis, the two plates curving to flatten themselves.

19. The following developmental periods appear to be generally applicable to insects:

(1) Preparatory to organ-budding: as segmentation, gastrulation, formation of blastoderm, of germ-streak, and of embryonal skin.
(2) Organ-budding.
(3) Growth of these organs, and appearance of some new ones before hatching.
(4) Post-embryonic development of larva; now the generative organs reach full development.—*G. Macloskie.*

NERVE-TERMINATIONS ON ANTENNÆ OF CHILOGNATH MYRIOPODS.—A preliminary note upon these structures is contributed by O. Bütschli; the results were worked out by Dr. B. Saupine in conjunction with Dr. Bütschli, but having been left in an incomplete condition, a brief *résumé* of the more important new facts seemed desirable.

Previous observers have noted the occurrence of conspicuous structures upon the antennæ of Chilognatha, which correspond to the so-called olfactory cylinders of insects recently studied in detail by Hauser, and between the two there seems to be a general similarity.

Each of the sensory processes is entered by a nerve which immediately divides into two branches, each covered with ganglionic cells which are distributed in two groups, the anterior one consisting of considerably smaller cells than the posterior ones; at the distal extremity the nerve-fibres again collect into a bundle and form the termination of the organ; that these fibers are differently constituted from those which enter the ganglion from above is shown by the fact that their behavior to staining reagents is different; the sensory process is often at the free extremity so that a direct communication is established between these nerve-endings and the outer world.

A structure essentially similar to this is found in Vespa, but is differently construed by Hauser; according to him the posterior group of cells is not present, since he only figures one nucleus *with several nucleoli*, however, while the anterior group of smaller cells has escaped his attention; accordingly the conclusion to which Hauser has arrived at is that the whole sensory structure is a single cell; whereas in reality it consists of a great number of cells.—*Journ. R. Micr. Soc., August, 1884.*

Poison Apparatus and Poison of Scorpions.—J. Joyeux-Laffuie, from his own studies and a consideration of what has been discovered by other naturalists, comes to the conclusion that the poison organ of the scorpion (*L. occitanus*) is formed by the sixth or last somite of the post-abdomen, which terminates by a sharp process, at the extremity and sides of which are two oval orifices by which the poison escapes. There are two secreting glands, each of which opens by an excretory duct to the exterior. Each gland is situated in a cavity, which it completely fills, and which is formed by the chitinous skeleton and by an enveloping layer, formed by striated muscular fibers; it is by the contraction of this latter that the poison is forced out. The gland has a central cavity which acts as a kind of reservoir, and a proper wall, which is formed by a layer of cells that send out prolongations into the cavity, and of a layer of epithelial cells, which, in the fresh condition, have a finely granulated protoplasm; these are the secreting cells. The poison is very active, and, even in weak doses, soon kills most animals, and especially arthropods or vertebrates. The phenomena of poisoning are always the same, and take place in the following order: (*a*) pain at the point of injury; (*b*) period of excitement; (*c*) period of paralysis. The conclusions which are characteristic of the second stage, are due to the action of the poison on the nervous centers, and especially on the brain; the paralytic phenomena are caused by the action of the poison on the peripheral extremities of the motor nerves, where they appear to have the same influence as curare. The muscles, the heart, and the blood are in no way attacked, and the poison may therefore be certainly placed among those which act on the nervous system. The scorpions found in France (*S. europæus*

and *S. occitanus*) cannot cause the death of a human subject, and are only dangerous when several poison a man at the same time, or attack very young children. To judge by his bibliography, the author is unacquainted with the observations on the habits of scorpions, published in 1882, by Prof. Lankester.—*Journ. R. Micr. Soc., August, 1884.*

Occurrence of Tachina Flies in the Tracheæ of Insects.—N. Cholodkowsky gives in Zool. Anzeiger (June 9) an account of a young larval Tachina 1 ^{mm} long found in the ventral stigma of a carabus beetle. He afterward found the same kind and another species of Carabus infested with fully grown Tachina maggots. He also found a *Harpalus ruficornis* literally packed with these larvæ. The occurrence of Tachina larvæ in the bodies of grown-up insects is, he adds, no new thing. In 1828 Bohéman found in *Harpalus ruficornus* and *aulicus* the larvæ of *Uromyia curvicauda;* Léon Dufour described *Hyalomyia dispar* as a parasite of *Brachyderus lusitanicus;* he also found the larva of Phasia in *Pentatoma grisea* and *Cassida viridis* and the larva of *Ocyptera bicolor* in *Pentatoma grisea.* Boye in 1838 took Tachinæ from three species of Carabus. Within a few years Künkel d' Herculais found the maggot of *Gymnosoma rotundatum* in the body of Pentatoma.

Eaton's Monograph of Recent Ephemeridæ. Part II.—We have already (p. 630) called attention to this elaborate work. This part concludes the descriptions of the species as well as the nymphs when known. A most important feature of this part is the illustration of the nymphs, which have been drawn with great detail and engraved by A. T. Hollick, filling twenty large plates. Between this magnificent work and the elaborate memoir by Vayssière, as well as the papers of Joly, the Ephemerids certainly have no reason to complain; though their own lives scarcely span a day, their historians have devoted years of research to them.

Structure and Function of the Legs of Insects.—We have already called attention to this essay by F. Dahl. The Journal of the Royal Microscopical Society for October contains an abstract of it, which our entomological readers will find of interest. The constancy of the number of six legs is probably to be explained as being in relation to the functions of the leg as climbing organs; one leg will almost always be perpendicular to the plane when the animal is moving up a vertical surface; and on the other hand we know that three is the smallest number with which stable equilibrium is possible; an insect must therefore have twice this number, and the great numerical superiority of the class may be associated with this mechanical advantage. This theory is not weakened, but rather supported, by the fact that the anterior pair of legs is rudimentary in many butterflies, for these are almost exclusively flying animals.

The author describes in some detail the arrangements of the muscles of the legs; the nerve-cord supplying them is pretty stout, and the large number of filaments sent to the joints of the tarsus lead to the supposition that these have a tactile function; the nerve-fibers are seen to enlarge into thick spindle-shaped ganglia. There are two tracheal trunks.

The prime function of the leg is locomotor, and insects move through gaseous, fluid and solid media. The last is seen in fossorial forms, of which Gryllotalpa may be taken as the type; here some of the joints are flattened out and provided with teeth, and the muscles are well developed.

In some cases, legs of a fossorial type are possessed by insects which move on the ground, but the larvæ of which are subterranean in habitat. The water-beetles and aquatic Rhynchota have the legs converted into swimming organs; they are widened out into plates, and provided at the sides with movable hairs, which are directed slightly backward. The median pair of legs in Corixa is provided with two very long hooks, the function of which is to fix the animal at some depth among the water-plants, and so to prevent its floating upwards.

In the aërial forms, we have first to notice those that move on the surface of the water; in these the legs are often provided with considerable enlargements of the tracheal trunk, by means of which they are enabled to float. Others have very long legs, by which they can balance themselves and extend over a large surface of the water; the lower surface of the tarsal joints, or that which is in contact with the water, is provided with thick hairs. In some Diptera hairy lobes are developed. Arrangements for climbing are very widely distributed, and are very various in character; the most common are hooks, which by their sharp tips are able to enter the smallest depressions, and so obtain a firm hold; sometimes they are pectinate and enabled to catch hold of fine hairs.

In very many cases there are organs of fixation; in the locust they have their chief mass made up of a large number of free flexible rods (not tubes). The periphery is occupied by scales which correspond in number to the rods, with which they appear to be connected by fibers; the space between the rods is filled with a fluid. Below these are groups of spindle-shaped cells which appear to be glandular in character. The fixing surface of the Hymenoptera, Neuroptera, and Lepidoptera consists of an impaired lobule placed between the hooks; their structure is most complicated in the first-named order. Observations on *Vespa crabro* did not result in the detection of any space which could be regarded as a vacuum. The lower surface of the lobule is soft and almost smooth; a few short hairs may be developed at its base; below this is a hard chitinous mass with stronger hairs. The upper surface is either covered with hairs or is finely folded. Near the base is a chitinous plate carrying a pair of strong setæ.

Within is an elastic bar, which is rolled up in a condition of repose; when extended it brings the lobule into contact with the surface on which the insect is standing. There are no well-developed gland-cells. After descriptions of other modes of fixation, the author gives the following table:

A. Organs of attachment at the end of the foot.
  a. Without fixing hairs ..... *Orthoptera.*
  β. With fixing hairs ..... *Forficula.* / *Coleoptera.* / *Sialis.*

B. Organs of attachment between the hooks.
  a. A distinct median lobe.
    a. The median lobe with chitinous arches.
      1. Secondary in addition to the median lobe. ..... *Neuroptera.*
      2. No secondary lobes. ..... *Hymenoptera.*
    b. No chitinous arches ..... *Lepidoptera.* / *Tipula.*
  β. No distinct median lobe.
    a. The lobes hairy ..... *Diptera.*
    b. The lobes not hairy. ..... *Rhynchota.*

The legs may, further, have a sexual function as attaching or holding organs; or, as in *Mantis religiosa*, *Nepa cinerea*, etc., they may be of use in seizing prey; and, finally they may be used as cleansing organs. The legs in ants may be seen to be pectinate, an admirable arrangement for forms that live in dust and earth; they are often especially adapted for cleansing the proboscis and for other functions, for an account of which we must refer to the paper itself.

Entomological Notes.—Dr. Brauer, says *Psyche* (Aug., Sept.) has noticed the transformations of a fly (*Hirmoneura obscura*) whose larva lives on that of the grub and pupa of the June beetle, *Rhizotrogus solstitialis*.——Mr. O. Lugger, according to *Science Record* has discovered a strange hymenopterous parasite infesting the larva of Tiphia, a black sand-wasp. The Tiphia lays its eggs in the larva of our June beetle (*Lachnosterna fusca*); the larva of Tiphia when nearly mature eats the white grub and then spins for itself a beautiful silken cocoon. This larva in turn is often infested by the larva of *Rhipiphorus pectinatus* or *R. limbatus*, the eggs of which have become fastened to the Tiphia, and in this way reach the Tiphia cocoon. Mr. Lugger has also found in the same cocoons small hymenopterous parasites.——Interesting cases of lack of symmetry among insects are described in *Psyche* by O. P. Krancher.——Mr. P. Cameron states in the *Entomologist's Monthly Magazine* for October that since the publication of the first volume of his Monograph of British Phytophagous Hymenoptera, wherein he gave an account of what was known up to that time of the occurrence of parthenogenesis in sand-flies, he has been able to prove experimentally its existence in thirteen additional species, including *Lophyrus pini*, of which males were bred.——The second number of Vol. xi, of the Transactions of

the American Entomological Society contains a synopsis of North American Trichopterygidæ, by Rev. A. Matthews, of England. He regards this as the most extensive family of the whole order of Coleoptera. Dr. Horn notices the species of Anomala of the U. S. and gives a synopsis of the U. S. species of Notoxus and Mecynotarsus, while pp. 177 to 244 are devoted to a synopsis of the Philonthi of boreal America.——Among the papers of value to American students in parts 1–3 of the Transactions of the Entomological Society of London, are Elwes' additional notes on the genus Colias; E. B. Poulton's notes upon or suggested by the colors, markings, and protective attitudes of certain lepidopterous larvæ and pupæ, etc.; Lord Walsingham's North American Tortricidæ; E. Saunder's notes on the terminal segments of aculeate Hymenoptera, and Forsayeth's life-histories of sixty species of Lepidoptera of Central India.——The Transactions of the Imperial Zoölogical-botanical Society of Vienna, for 1884, are rich in valuable entomological papers. Dr. R. Latzel describes (p. 127) two new species of Eurypauropus, myriopods of the order Pauropoda, from Austria, showing that this genus is common to North America and Europe.——In the same volume von Wattenwyl, under the title "Ueber hypertalische nachahmungen bei den Orthoptera," notices and illustrates two cases of mimicry of dead colored leaves by a Phaneropterid grasshopper. The second form is wingless and strikingly resembles a worker ant. It is named *Myrmecophana fallax*.——The fourth part of the Transactions of the Entomological Society of London contains, among other papers two of much general interest by Baron Osten Sacken, *i. e.*, facts concerning the importation or non-importation of Diptera into distant countries, and an essay on comparative chætotaxy, or the arrangement of characteristic bristles of Diptera.——A carefully prepared and very just tribute to the memory of our greatest entomologist, Dr. John L. LeConte, by S. H. Scudder, appears in advance from the Transactions of the American Entomological Society.——We have received a well illustrated report on the tea-mite and the tea-bug of Assam, by J. Wood-Mason, of Calcutta; the mite puncturing the leaves so that "a badly smitten garden may be recognized from a distance by its red color," and the bug also blighting the leaves. It appears that of the two species of tea plant cultivated in Assam the indigenous species which affords the strong and rasping liquor, when pure, enjoys an almost complete immunity from attack, while the milder juices of the imported Chinese bush render it liable to attack. Mr. Mason then asks how the bugs distinguish between different but closely similar plants, infallibly selecting the right food-plants for their larvæ.——At a meeting of the London Entomological Society held July 2, Dr. Sharp remarked that *Cybister ræseli* has been kept alive from five to seven years by being fed on earthworms once or twice a day.——Dr. Witlaczil has published in

the Transactions of the Vienna Academy of Science an essay on the polymorphism of an Aphis (*Chætophorus populi*).——A new cave-spider, says *Science-Gossip* for December, has been found in a cave in Tasmania, the female of which measures six and a half inches from tip to tip of the fore and hind legs.——Sharp has detected on the prothoracic stigma of the beetle (Chalcolepidius) trap-door like lobes closing them so as to prevent the entrance of small mites (Proc. Ent. Soc. London, p. iii).

ZOÖLOGY.

THE DEEP-SEA EXPLORATIONS OF THE "TALISMAN" (*continued*). —The Sargasso sea was then visited, and deep-sea soundings made to ascertain the nature of the bed of that part of the ocean. From Cape Verde, the ocean gradually deepens toward the 25th parallel, when it attains a depth of 6267 meters; but it gradually rises toward the Azores, and, under the 35th parallel, it is not over 3175 meters deep. These results are far from being in accord with the indications on the charts of the Atlantic ocean recently published, where the curves of depth give very considerable inequalities.

Whenever soundings were made, specimens of a very fine ooze, formed of fine particles of pumice, mixed with globigerina, were brought up. This ooze, at first reddish near the Cape Verde islands, afterward became of an almost pure white. Each time the dredge furrowed the face of the sea bottom, it was more or less filled with fragments of pumice stonea nd of volcanic rocks. It would seem as if there were, more than a league under the sea, a great chain of volcanoes parallel to the African coast, and of which the Cape Verde islands, the Madeiras, the Canaries and the Azores were the only points of emergence.

The submarine fauna there is scanty. To the stones were attached brachiopods (*Discina atlantica*). A blind Fusus (*Fusus abyssorum*), and a new genus of Lamellibranchs (*Pygotheca fragilis*), as well as several Pleurotoma, occurred. Some Crustacea, such as hermit crabs (*Pagurus pilimanus*), which lodge in colonies of Epizoanthus, and which have already been dredged on the African coast, some amphipods of the genus Nematocarcinus, Holothurians of the group of Elpidia, of which one species was new, Asterians, Ophiurans, and rare corals, scarcely indemnified the party for the time given to dredging at such great depths.

It was only toward the north limits of the Sargasso sea, near the Azores, where the depths are 3000, 2500 and 1400 meters, that our collections became abundant. The 11th of August, at 2500 to 2900 meters, the *Talisman* party captured the giant of the family of Schizopodes—a Gnathophausia, of a blood-red, measuring almost 0.25 millimeters in length, and meriting well the specific name of Goliath, which has been applied to it. In

the same dredge with this crustacean was found a fish of the group of Stomias, with lateral phosphorescent plates. Further on, at 1500 meters, several mollusks of unknown species (Scaphander, Pleurotoma, and Oocorys), the *Dentalium ergasticum*, a great variety of Crustacea, Holothurians, Asterians, Ophiurans and other Echinoderms, contrasted with the penury of the preceding days.

After visiting Fayal, the *Talisman* explored the uneven volcanic bottoms of the passages between the Azore islands, making several successful hauls at the depth of 1250 meters. Some fishes, large red Aristes, Heterocarpus, Galateas of the genus Diptychus, a squid (Cirrhoteuthis) peculiar to Greenland, Actinias, whose edges close together like a bivalve, many star-fishes, specimens of Lophohelia, with their usual retinue of Mopsea, soft sea-urchins (Calveria), large and beautiful Holtenias, recalling the dredgings some weeks previously off the coast of Morocco.

At a little distance from St. Michel, the declivity of the sea-bottom is very rapid. Some hours after our departure, our sounding apparatus already indicated almost 3000 meters, and some of the species found on the plateau situated west of Cape Ghir were brought up. Among others, some large Holothurians, of an amethystine color. On the following day the depth was 4415 meters, and for four days after it continued to be about the same. 4060 meters the 24th, 4165 the 25th, 4255 the 26th.

The very large fishes of the genus Macrurus, which had been brought up during the expedition, also occurred here. They differed fromt hose of lesser depths. The Scopeli and Melanoceti were here also associated. Some hermit crabs and Galatheas of new form; some Crangons, with red eyes; a gigantic Nymphon of the genus Colossendeis; some Ethusas, different from those already known; some Amphipods and Cirripedes represented the Crustacea.

But this abyssal fauna owed its special physiognomy to the large Holothurians of strange forms which abounded; some whose length reached 065 millimeters, and whose violet colors were very intense, belonged to a new species of the genus Psychropotes, so remarkable from the existence of a very much developed appendage, ending behind the body, and resembling a queue; others, of the genus Oneirophanta, were easily recognized by their pure white color and long appendages, which garnished the whole body. Others of a delicate rose, carried on the back an erectile, fan-like membrane; these new Pentagonias were like those found by the *Challenger* at the greatest depths explored. Finally, large Actinians, some of which lived as parasites on the Holothurians, some Hymenasters, Asterians, a Brisinga with few arms, some Ophiurans and a crinoid, were found in the same situations.

Aug. 27th, the sounding apparatus reached a depth of over

5000 meters, and a new species of Neæra, and different Crustacea occurred with others previously dredged. More than fifty rosy Pentagonias were dredged, mixed with a less number of Oneirophanta, Archaster and Ophiomusium, attested the richness of this deep sea fauna.

The bottom of the sea throughout this region is carpeted with a white ooze formed almost entirely of globigerines. Pumice and volcanic stones are mixed with it; but that which surprised us most was to find some pebbles polished and striated with ice at a distance of more than 700 miles from the coast of Europe. The distinctness of the striations could not allow us to admit that these pebbles had been transported by currents, because they would never have rolled, and, besides, they lay at such a great depth, that the tranquillity of the water there should be very great, to judge by the nature of the ooze deposited there. Their presence is probably due to transportation by floating ice, which, during the quaternary epoch, advanced further south than in our day, and which, melting in the part of the Atlantic ocean lying between the Azores and France, let the stones fall on the bottom with the fragments of rocks torn from the bed of the glaciers, and which they had transported there.

Aug. 30th, dredging at the depth of 1480 meters in the Gulf of Gascony, revealed polyps of the genus Lophohelia, with splendid Pentacrini (*P. wyville-thompsoni*), gigantic Mopseas, Gorgonias, and corals, etc.—*A. S. Packard.*

The Nervous System of Antedon.—Various opinions have been held in regard to the nervous system of the crinoids which has been held by some to consist of the bands along the bottom of each ambulacral groove corresponding to the nerve cords of the star-fish, while others have maintained the nervous nature of the axial cord and its connections. Dr. Carpenter first suggested the nervous nature of this cord in 1865, and in 1874 further developed the theory that the axial cords are nerve-trunks, and the five-chambered organ in the centrodorsal basin is their center, and as proof adduced the fact that an eviscerated specimen suddenly and consentaneously closed its ten arms when a needle was thrust into the chambered organ. P. H. Carpenter, in 1876, was the first to maintain the nervous character both of the sub-epithelial bands of the ambulacra and of the axial cord. Recent experiments, carried on by Dr. A. M. Marshall, have established conclusively that the central capsule and axial cords, with their branches, constitute, as maintained by the Carpenters and Perrier, the main nervous system, while the sub-epithelial bands are also probably nervous, but have only a special and subordinate function in connection with the ambulacral tentacles and epithelium. The complex co-ordinated movements of swimming and righting when inverted, are all executed by the axial system, as was

proved by the fact that eviscerated specimens in which the connection of the sub-epithelial bands with each other was destroyed, were capable of executing these movements. The axial cords act both as afferent and efferent nerves. Evisceration causes apparently but little inconvenience to the animal, and the visceral mass is regenerated completely in a few weeks. The apparent morphological difference between the nerve system of the Crinoidea and of other echinoderms disappears upon examination. Taking the Asterids as the lowest term of the series, it will be found that in those creatures, as shown by Hamann, nerve fibrils are found over the entire dorsal surface of the animal. While in Ophiurids, Echinids and Holothurids the ambulacral portion of the continuous nervous sheath of the star-fish has concentrated into a well-defined cord, the remainder being absent; in the crinoids the ant-ambulacral or dorsal part being continuous nerve-sheath of the star-fish has developed into the so-called axial cords, and the ambulacral bands also subsist as a subordinate nerve-system.

HERRICK'S CLADOCERA AND COPEPODA OF MINNESOTA.[1]—In this excellent report we have for the first time a summary of the known genera and species of all our fresh-water, free swimming Entomostraca with the exception of the Ostracodes. It will prove not only useful but stimulating to our inland naturalists. As a pioneer work it is entitled to much credit, since many of our species are identical with those of Europe, and much care is required in the generic and specific descriptions, since the distinctions are based on such slight characters. In the introduction the author shows how important these micro-crustaceans are as scavengers, and in what astonishing numbers they exist, 1442 specimens occurring in a quart of filthy pond water.

The discussion of the affinities and genealogy of the Cladocera is interesting; this is succeeded by an account of the leading works on them. The order, families and genera are characterized with sufficient fullness, and a tabular view of the classification of the Cladocera is given, as well as useful keys to species under each genus. Under the family Daphnidæ a long account of the circulatory system is given from original observations, The Copepoda are treated in the same manner as the other order, and all the species collected by Mr. Herrick or previously known are described, but why no description of *Canthocamptus tenuicaudis*, n. sp., is given, we hardly understand, though it is figured, while *C. cavernarum* Pack., from Mammoth cave, is not mentioned. The number of species of Copepoda seems meager, and

[1] A final report on the Crustacea of Minnesota, included in the orders Cladocera and Copepoda. Together with a synopsis of the described species in North America, and keys to the known species of the more important genera. By C. L. Herrick. From the twelfth annual report of the Geological and Natural History Survey of Minnesota, 1884. 8vo, pp. 191, with 29 plates.

as the author suggests, many new forms remain to be detected. Notes on collecting and preserving these forms, and a few descriptions of marine copepods from the Gulf of Mexico are added. The figures are numerous and fairly well drawn, some being anatomical and embryological in their nature.

The work will do credit to the author and be of service in directing attention to these creatures, and it is to be hoped that the author will be able to add to and extend the work, and in a few years give us an enlarged and improved edition of it, as a hand-book of our fresh-water Entomostraca would be useful.

The plates should have been numbered not lettered; *Limnetis* is spelt *Limnetes*, but the typographical errors are not numerous.

Morphology of the Vertebrate Auditory Organ.—The chief vertebrate sense organs have certainly had a very different origin. The olfactory organ is probably a modified gill (Marshall). The eye is developmentally and really part of the brain. Such a view was also once held with regard to the olfactory and auditory nerves as well as the eye. But recent researches, especially those of Marshall and Van Wijhe, have proved that the auditory nerve is merely a dorsal sensory branch of the 7th cranial nerve (3d segmental nerve of Van Wijhe).

It has been shown above that the nerves which supply the segmental sense organs are dorsal sensory branches of the segmental nerves, that the segmental sense organs are merely modified portions of the epiblast, that these sense organs primitively, and in some existing form still throughout life, lie free on the surface of the body, but that later in most cases they become shut off from the epidermis in a sac which remains connected with the external world by a small opening. The sensory cells of these organs possess long fine terminal hairs, which are easily affected by wave-motions in the medium in which the animal lives, and which communicate this wave motion to the nerves connecting them with the brain. Do we really meet with this condition of things in the auditory organ? In other words, is the auditory organ merely a specially modified portion of the system of segmental sense organs?

The auditory organ is, like the segmental sense organs, really a modified portion of the epiblast. Very early in development it becomes shut off in a sac from the epidermis, a condition which only arises later in the segmental sense organs.

The semicircular canals, etc., are clearly secondary complications, for in every embryo the auditory organ is at first a simple sac shut off from the epidermis, of which sac a portion of the inner wall consists of two layers of modified epiblastic cells, connected by a dorsal sensory branch of a segmental nerve with the brain.

This double layer of modified epiblastic cells is in every way

comparable to a segmental sense organ. As in the latter the cells on the free surface possess long hairs. These hairs like those of the segmental sense organs are concerned with the perception of wave-motions of the medium in which the animal lives. The hairs on the auditory cells are indeed concerned with the perception of much finer wave-motions—those of sound—than those on the cells of the segmental sense organs, and hence arises the early shutting off of this organ from the skin. The inner layer of cells of the auditory organ is exactly comparable to the inner layer of cells of a segmental sense organ.

In Teleostei, etc., the auditory organ becomes entirely shut off from the skin, but in Elasmobranchii the aperture of invagination persists, and the organ is connected with the surface throughout life, just as the segmental sense organs.

These facts, together with the fact that the auditory nerve is merely a dorsal sensory branch of a segmental nerve, seem to point to the conclusion that the auditory organ of vertebrates is fundamentally a specialized portion of the system of sense organs of the lateral line, specialized above the rest of the system by the acquirement of the more delicate function of the perception of waves of sound.

In accordance with, and as a direct consequence of this function of receiving waves of sound, the auditory organ has been early shut off from the external surface, and has developed accessory structures in the shape of semicircular canals, etc. Thus its primitive simplicity has been lost.

I hope shortly to give elsewhere a more detailed statement of the points touched upon in this paper.—*John Beard in Zoölogischer Anzeiger, 1884.*

Some preliminary notes on the Anatomy of Fishes.—1. *On the cutaneous Sense-organs.*—Since the distinction between *endknospen* on the one hand, and *nervenhügel*, *nervenleisten*, *nervenknöpfe* on the other, is generally recognized, it becomes desirable to have English equivalents somewhat less clumsy than the literal translations of these terms. I have found no satisfactory word to replace "endbud," but would suggest for the "nerve-hillocks" and other sense-organs of the same character, whatever their shape, the term *neuromast* with the adjectival form *neuromastic*.

At the meeting of the British Association in Montreal, in September, I pointed out that the catfish possesses neuromasts in sacs, recalling those of the sturgeon. They resemble these, in fact, more closely than do the similar structures of Amia and Lepidosteus, which I have recently studied. The neuromasts belonging to a group are connected by a canal lodged in the corium, which is lined and in places filled by an epithelium, continuous with the epithelium of the neuromasts. Such a canal

has recently been described by Carrière for Cobitis, although he has not recognized its true character. The deep neuromasts found by the same author in Tinca are evidently somewhat similar to those ot the catfish, and it is probable that connecting epithelial canals will yet be found. The only explanation of these canals which has so far occurred to me is, that they are the remains of a more complicated system of cutaneous canals similar to those of the Selachii.

In striking contrast to such deep neuromasts are those lodged on the projecting papillæ of the blind fishes. Professor S. A. Forbes has described the distribution of these in his *Chologaster papilliferus*, a specimen of which he has kindly given me for examination. I find that whereas the trunk in this species has only the free neuromasts, the head has neuromastic canals arranged in the ordinary way, and corresponding roughly in their course to the chief tracts of the projecting papillæ. A singular circumstance is, that they have only four openings on each side, one posterior above the gill-aperture and three anterior on the snout, the pores of the mandibular, infraorbital and supraorbital canals respectively.

I take the opportunity of mentioning here that the absence of pigment in the pigmentary epithelium of the retina of this species as very significant.

2. *On the fate of the spiracular cleft in Amia and Lepidosteus.*—It is generally supposed that the spiracles of the sturgeon are unrepresented in Amia and Lepidosteus, but a minute slit may be seen in both genera on either side of the roof of the mouth, immediately in front of the dorsal ends of the first branchial arches, leading into diverticula of the mouth-cavity—the rudimentary spiracles. If a bristle be pushed into one of these slits, it will be found to pass through a canal in the primordial cranium immediately above the anterior end of the hyomandibular articulation, and to be only prevented from emerging on the roof of the skull by the squamosal bone. Sagemehl has seen the canal in Amia without attributing to it any morphological significance. In series of sections through young specimens of both genera, I find a free neuromast projecting from the epithelium of the anterior wall of the distal part of the cleft, supplied by a distinct division of that dorsal branch of the *trigeminus* (the *ramus oticus* of Van Wijhe), which is distributed to the neuromastic canal in the squamosal bone. I conclude that the distal part of the cleft is epiblastic in origin, although Balfour believed (as far as Lepidosteus is concerned) that it never acquires an opening to the exterior. In a recess of the anterior wall of the spiracle in Amia is situated a pseudobranchia. This has recently been styled an "opercular pseudobranchia," in accordance with Gegenbaur's views as to the homology of the pseudobranchia of the Teleosts, but the discovery of its relations to the spiracular cleft demon-

strate its homology with the pseudobranchia of the sturgeon. As there can be no doubt of the homology of the pseudobranchia of Amia with that of the Teleosts, it follows that it is the "opercular" gill and not the spiracular gill which disappears in the Teleosts. Dohrn has recently defended this from another standpoint. Johannes Mueller's view is in opposition to that of Gegenbaur.

The pseudobranchia appears to be represented in Lepidosteus by a mere anastomosis. That genus, has, however, an "opercular" gill (absent in Amia), the two parts of which, although differing in their vascular supply, correspond to the complete opercular gill of the sturgeon. Balfour was unable to find this gill in young specimens of an inch in length. I have arrived at the above result from the study of specimens of two inches.

3. *On the auditory organ of Hypophthalmus.*—In a recent paper I described the connection between the air-bladder and auditory organ in the catfish (Amiurus), paying special attention to the morphology of the modified anterior vertebræ which establish this connection.

Reissner had previously pointed out that in many tropical Siluroids this "Weberian apparatus" is much reduced, but his identification of the altered vertebræ is so out of harmony with my results that I was glad to be able to re-investigate the matter through the liberality of Professor B. G. Wilder, who put at my disposal last spring a number of the forms in question as well as others. As was to be expected, the four anterior vertebræ are always modified in a similar manner throughout the group.

The genus Hypophthalmus, according to Günther, presents an exception to the other Siluroids, in that the anterior vertebræ are not united, but as a fact this genus exhibits an extreme type of reduction of the Weberian apparatus. The four anterior vertebræ are not only united, but the first three of them are telescoped, as it were, into the occipital region of the skull, so that a frontal section through the plane of emergence of the third pair of nerves, falls also through the *sacculi* of the auditory labyrinth. The air-bladder is represented by two entirely separate bladders, about 2^{mm} in length by 3^{mm} in width, almost entirely enclosed in osseous capsules, situated on either side of the fourth vertebra, and coalesced with it. These osseous capsules represent the crescentic ossifications in the external tunic of the air-bladder of the catfish which are attached to the posterior ends of the "*mallei*." All the Weberian ossicles are represented, but the whole apparatus is so reduced as to be obviously quite functionless. In conformity with this the *lagenar* parts of the auditory labyrinths are much smaller than in the catfish, while the *sacculi* of opposite sides still communicate by a transverse duct.

In compensation, as I think, for the reduction of the Weberian apparatus, the neuromastic canals of the head and trunk are

enormously developed, and the dorsal branches of the various cranial nerves which supply these, and which center in the *tuberculum acusticum* of the brain, are correspondingly large. This appears to me an additional confirmation of the theory advanced by Schultze and Mayser, that the cutaneous sense-organs of this class constitute a form of auditory organ.—*R. Ramsay Wright, University College, Toronto, Dec. 18, 1884.*

P. S.—After writing the above, I learn from Professor Wilder that he indicated the existence of rudimentary spiracles in Amia and Lepidosteus at the A. A. A. S. in 1878. His MS., which remains unpublished, discusses the nature of the spiracles and their persistence in a more or less complete form in Selachians, Ganoids and the Teleost Megalops, describes the form and relations of the spircular clefts in the adult Amia, and concludes that these are open in the young.

The relation of the pseudobranchia referred to above is not indicated.—*R. R. W.*

THE LARVA OF ESTHERIA MEXICANA.—(The following descriptions and figures were received from the late Mr. V. T. Chambers in 1873, and overlooked in the preparation of my monograph of North American Phyllopoda. As we know nothing of the development of American Estheriæ except what is given by Dr. Gissler in my monograph, it may be well to publish the drawings and description of Mr. Chambers. I have identified the species from specimens of the shell sent by the author.—*A. S. Packard.*)

I send by this mail the fragments of the shell of the Estheria and two camera drawings of the nauplius in different stages, and a drawing of a section of the shell showing the markings. I do not know whether the nauplius has been previously figured or not, as my knowledge of the genus is confined mainly to Baird's monograph in *Ann. and Mag. Nat. Hist.*, Ser. 2, Vol. VI, p. 53; T. R. Jones in *Quar. Micro. Journal*, and a few references in the *Zoölogical Record.*

Most probably this is your described Kentucky species.[1] Out of the hundreds of eggs only four produced Nauplii, and unfortunately I was only able to observe these in the stages figured. The first form (Fig. 1) was evidently just from the egg, and was observed at 3 o'clock P.M., Sept. 15; the second was observed next day at 8 A.M. I have a preserved specimen of each form: Fig. 2*a* is the shield, which seems to be attached only to the anterior portion of the under side of the thorax; Fig. 2*b* is a side view of the head at this stage, except that the abdomen is too short. Fig. 1 bears a good general resemblance to Baird's figure of *Artemia iun.* It seems to me, however, to approach more

[1] *E. clarkii*, now regarded as a synonym of Claus' *E. mexicana.*

nearly the young of Chirocephalus, especially in Fig. 2.—*V. T. Chambers.*

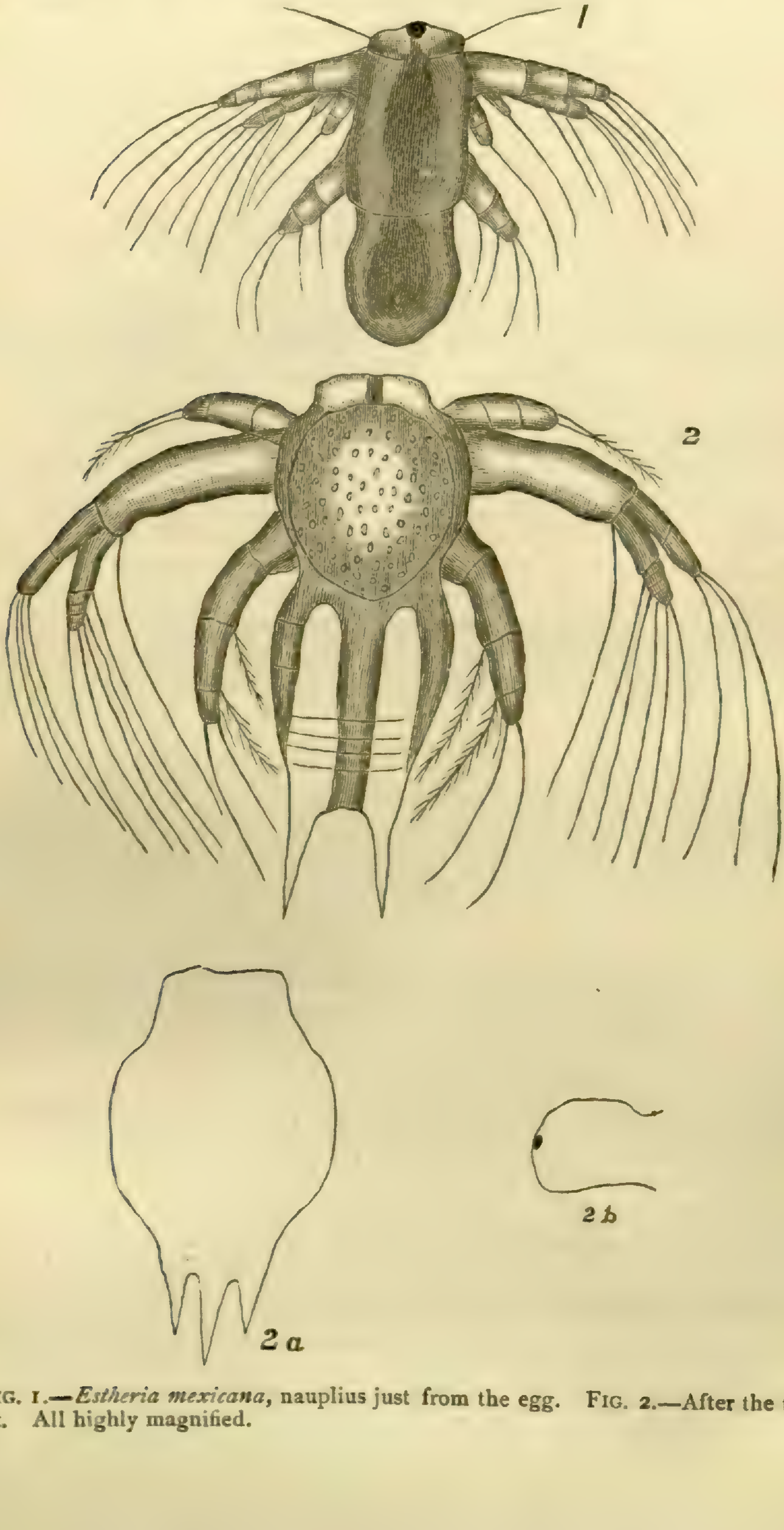


FIG. 1.—*Estheria mexicana*, nauplius just from the egg. FIG. 2.—After the first molt. All highly magnified.

ABERRATION IN THE PERCH.—I wish to note a peculiar anatomomical aberration in a common perch (*Perca americana*) which has just come under my observation. In examining some of these fishes from Lake Michigan, an assistant noticed that one of them had no pyloric cœca. The viscera were placed in alcohol with others, and on opening the alimentary canal for the purpose of removing its contents, I noticed a fleshy mass apparently nearly occluding the pyloric opening, the pyloric portion of the stomach being stretched somewhat tightly over it. Finding that this was not detachable I took it for a tumor, but a closer examination showed that it was divided into three finger-like lobes, of the shape and size of pyloric tubes, and that each of these lobes was hollow, opening upon the outer surface of the intestine by an orifice large enough to admit a knitting-needle. Evidently these were the missing pyloric cœca, which had *grown wrong side out;* for I cannot conceive of any accident which should turn these structures within the body of the fish.

The exposed surface is a mucous surface, and that within the cavity of the pyloric tube is a serous surface, like that of the outside of the intestine.—*S. A. Forbes.*

A LIZARD RUNNING WITH ITS FORE FEET OFF THE GROUND.—In the proceedings of the Linnean Society of New South Wales, 1884, it is stated that Mr. Macleay exhibited a lizard which was observed to run for six yards in an erect posture with the fore legs quite off the ground. The lizard was of the genus Grammatophorus, of which there are several species in the country, all of them much given to playing and gambolling on sunny days.

FEATHERS OF THE DODO.—The feathers of the dodo have been studied by Professor Moseley,who read a paper on the subject at the Montreal meeting of the British Association. He showed that the arrangement of the feathers in groups of three each in the dodo had a close connection with the *filoplumæ*, or thread-feathers, one of which is found at each side of the feathers of birds of the dove family, near which the dodo is placed. Earlier in the development of the dove's feathers the *filoplumæ* are larger, relative to the size of the other feathers; and this condition resembles still more the structure found in the dodo.

THE ARMADILLO IN TEXAS.—G. H. Ragsdale, of Gainesville, Texas, informs me that an armadillo was recently killed in northern Denton county, Texas, which is the only animal of the kind ever taken in that part of the country. The armadillo is said to have been common on the Rio Grande river twenty years ago, and is still common in the south-western counties of Texas.—*A. Hall (E. Rockfort, Ohio), in Forest and Stream.*

ANOTHER SWIMMING WOODCHUCK—On page 249 of Dr. C. Hart Merriam's interesting work on the Mammals of the Adirondacks (New York, 1884), the author states that with the ex-

ception of a single case which came under his personal observation, and which he relates in full, he has searched in vain for the record of an instance where a woodchuck (*Arctomys monax*) has been known to swim voluntarily. An instance somewhat similar to the one mentioned came under my own notice in the early part of July, 1877, whilst camping within a few miles of the village of Kempville, some thirty-two miles south of Ottawa. In company with Mr. P. B. Taylor, of the post-office department, I was rowing up "the Branch," a small tributary of the Rideau, when we noticed a large woodchuck come down the bank and take boldly to the water, with the evident intention of crossing to the other side. The stream was at this point about 30 or 40 yards wide, and we pulled hard in order to come up with the animal before he could reach the opposite shore. As soon, however, as the woodchuck saw us he appeared to take in the situation, and made vigorous efforts to escape; and as he could change his direction much more quickly than we could, he succeeded for some time in eluding us. But we finally managed to get within reach of him and I lifted him into the boat by the back of the neck. He shivered a good deal and looked intensely uncomfortable; but his long swim did not appear to have tired him much, for he struggled violently to free himself, and when subsequently released he leaped over the side of the boat and swam back to the shore from which he had come. He swam low in the water, progressing but slowly and with evident exertion.—*W. L. Scott, Ottawa, Canada.*

Nest of Neotoma floridana (identified by Dr. Coues, with question).—While hunting, the other day, my attention was called to a singular nest of some animal, made on the ground, just in the edge of a clump of mesquite brush. It was in the form of a pyramid or rather oval, about two feet and a half high, and four feet in diameter at the base, constructed of cow chips, stones, sticks, lumps of dirt, and every imaginable light substance that could be collected in the vicinity. There were two holes for entrance in the nest, on opposite sides, about the size of one's coat sleeve. A large thick cactus leaf near one of the orifices had been partly eaten recently. As far as we could ascertain, without destroying the nest, it was unoccupied at the time of our visit. My companion, the signal observer here, is very familiar about here, but this is the only nest of the kind he has seen. A gentleman, who has lived on the Rio Grande, says he has seen them. Can any one tell us what animal lives in this curious nest?—*John D. Parker, Fort McKavett, Texas.*

Haacke's Discovery of the Eggs of the Australian Echidna.—It appears that on Aug. 25, a few days before the announcement (Aug. 29) by telegraph from Australia, of Caldwell's discovery that a monotreme laid eggs, the telegram not

stating whether it was the Ornithorhynchus or Echidna, Dr. J. W. Haacke discovered that Echidna laid eggs. His discovery was reported in the same number of the *South Australian Register* as contained Caldwell's dispatch to the British Association at Montreal. On Sept. 2d, at a meeting of the Royal Society of South Australia, the *Register* reports: "Dr. Haacke laid a number of specimens on the table, including an egg found in the pouch of a female Echidna, in support of the theory that the Echidna, although a milk-giving animal, lays eggs which are hatched in the pouch." Dr. Haacke, in a communication to the *Zoologischer Anzeiger* of Dec. 1, adds: "I found the egg on the 25th of August last in the mammary pouch (not the uterus) of a living *Echidna hystrix*, received about the 3d of the same month from Kangaroo island. The egg was unfortunately decomposed inside, but the circumstance of the mother having been worried by being captured and kept in captivity easily accounts for this." He also says that in dissecting the Echidna he felt a small object in the pouch; in hopes of finding a young Echidna he brought it to the light, and was astonished to behold a veritable egg between his fingers! It was from one and a-half to two centimeters in diameter, and possessed, as many reptilian eggs, a pergamentaceous shell which, under the pressure of his fingers, burst, letting out thick fluid contents. The scientific public will now look with interest to Mr. Caldwell's account of his discovery.

Distribution of Mammals.—At the Montreal meeting of the British Association Dr. G. Dobson read a paper on the distribution of mammals, in which he pointed out the remarkable resemblance between certain bats of the Australian and Ethiopian regions. From this it was apparent that some communication once existed between those continents. There probably had been a chain of islands between Australasia and Africa, which had existed for a short period, by which route the bat had passed from one place to another. Bats were widely spread in Madagascar, Mauritius, and Australia, but there is only one species in India which shows a strong resemblance to the Madagascar bats. So it is evident that at no distant day they had common ancestors. It was, therefore, deduced that there must have been a chain of islands from Australia to Madagascar, and at a later period from Madagascar to India. On close examination he felt convinced that the Indian ocean contained many submerged banks between Australia, Madagascar, and India. Professor Moseley said that the Indian ocean had never been examined as to depth, the *Challenger* expedition not touching it. Dr. John Ball urged that the existence of islands and continents was often too dogmatically laid down; he believed that currents could carry trees which might bear animals and plants with them.

On the Centrale Carpi of the Mammals.—Professor H. Leboucq, in his "Recherches sur la morphologie du carpe chez les mammifères," Arch. de Biol. Tom. v, 1884, pp. 35–102, pl. iii–vi, has made extended communications on this subject. I will add some observations, which will complete Leboucq's results. In this present communication I will speak of the centrale only, and will defer other points discussed by Leboucq to a future extended paper on the morphogeny of the carpus and tarsus of the vertebrates. I have found, like Leboucq and others, a distinct central bone in man, dog and cat. I regret not having been able to examine embryos of bats and marsupials. I can distinguish a centrale in two other specimens of Carnivores, in an embryo of Lutra of $50^{mm.}$ and in an embryo of *Mustela vulgaris* of about $25^{mm.}$ In Lutra the central bone was quite free and very fully developed, the radiale and intermedium were coalesced. In the embryo of Mustela, very much smaller and younger, the centrale was beginning to coalesce with the radiale and intermedium, at that part contiguous to the radiale. In Lutra the radiale and intermedium were entirely coalesced, in Mustela I found traces of a former separation.

In an embryo of *Erinaceus europæus* of $65^{mm.}$ I found no sign of a free centrale and no indication of a confluence of the bone with the radiale. The first tarsal row consisted of two pieces of cartilage, a radiale and intermedium, and an ulnare. In an adult *Erinaceus collaris* I observed the same condition as in the embryo. As in the different families of Insectivores, even in the adult state, a free centrale may be found or not, I do not hesitate to believe, that in all Insectivores in which a centrale has not yet been seen, such a bone will be discovered in embryos at some early stage of their development.

In regard to the Marsupials I have had no opportunity to examine the embryo.[1] In the manus of the following adult Marsupials I can distinguish an os centrale coalesced with the radiale, as Leboucq has stated, viz: *Didelphys azaræ*, *Perameles lagotis* and *Dasypus maculatus*. Further I can state the same for Ornithorhynchus and *Myrmecophaga tetradactyla*.

A centrale carpi is therefore now shown to occur in all orders of mammals except the Ungulata and the Cetacea.

Hyrax capensis possesses, as is well known, a free central bone. Professor Cope places the Hyracoidea together with the Condylarthra in the order Taxeopoda, and considers these the oldest ungulates. If there is a free centrale in one of the oldest ungulates, *Hyrax capensis*, such a bone should exist in the allied forms of this and in the descendants of the Taxeopoda, and I have no hesi-

[1] Since writing the above, I have distinguished in an embryo of Didelphys, 9.5^{mm} long, a partially free central bone. My thanks are due Professor H. Osborn for the opportunity of making the examination.

tation in believing that such a bone will be found in the Amblypoda[1] and in embryos of Elephas, Tapir, Rhinoceros and Hippopotamus. Whether it is coalesced with the radiale or with the trapezoid (tars.^{II}) or whether it has become wholly atrophied, I am not able to decide. (According to Flower: Osteol. of Mamm., II edit., p. 265, in *Hyrax dorsalis* the central bone is coalesced with the trapezoid.) It would be interesting to know whether in the Periptychidæ, the Phenacodontidæ and the Meniscotheridæ, the three families of Cope's Condylarthra, indications of a central bone can be found. It seems improbable that such indications must exist. Furthermore in regard to the Cetacea. If Leboucq's hypothesis, that we might consider in these animals certain "metacarpiens" as "carpo-metacarpiens" should be shown to be correct, then this last point would be elucidated.

Further morphogenetic researches on the limb-skeleton of the vertebrates will remove many present uncertainties and errors. I would hence be glad to receive, from those interested in the subject, any embryological material that will enable me to make further investigations upon these points. The most important stages are, when cartilage begins to appear, or is already developed. In future studies I hope, so far as possible, to elucidate the morphology of the limb-skeleton of vertebrates and to bring to light new points on the phylogenetic relations of the different groups of vertebrates.—*Dr. G. Baur, Yale College Museum, New Haven, Conn., Oct. 1884.*

The Trapezium of the Camelidæ.—Professor Cope[2] says in regard to the carpus of Poëbrotherium, one of the ancestors of the Camelidæ: "The carpus consists of eight bones, the entire mammalian number, all entirely distinct. The second series presents the most important peculiarities. The trapezium is small and posterior; the trapezoides has an almost entirely lateral presentation, and is also small, and fits an angle of the magnum. There are two principal and two rudimental metacarpals. The second and fifth are very short and wedge-shaped, and closely adherent in shallow fossæ of the third and fifth, respectively."

It is generally considered that the living Camelidæ have no trapezium. I cannot, however, agree with this assumption. At the posterior part of the trapezoid of an adult *Camelus bactrianus* L., I find a well developed articular surface; it is the same face that is seen in different Cervidæ,[3] and can only be for the trapezium.

[1] Professor Cope believes that there is an os centrale ("intermedium") in Coryphodon.

[2] Annual Report of the U. S. Geol. and Geog. Survey for 1873. Washingion, 1874, p. 499.

[3] Baur, G. Der Carpus der Paarhufer. Eine morphogenetische Studie (Vorläufige Mittheilung). Morphol. Jahrb. 9, 1884, pp. 600.

Between Poëbrotherium and the living camels stands, according to Professor Cope,[1] the genus Procamelus. In regard to this latter, Cope says, p. 262: "Thus the lateral rudimental metacarpals of Poëbrotherium have disappeared, and with them the trapezoides of the carpus." (This is evidently a typographical error; instead of trapezoides it should read trapezium.)

Now if there is a trapezium in one of the living Camelidæ, as I have found, there ought to be one in the older form—Procamelus. That this is in fact so, seems apparent from the figure given by Cope[2] of *Procamelus occidentalis* (Pl. LXXIX, fig. 3*a*). There appears to be an articular surface, at the back part of the trapezoid and it would be interesting to prove it definitively.

The presence of a trapezium in the Camelidæ shows that they, like the Cervidæ, are ancestral forms of the ruminants. I will discuss this in another place.

I do not doubt that we will find in the carpus of camel embryos the same condition as in Poëbrotherium. It would be interesting to examine embryos with this view.—*Dr. G. Baur, Yale College Museum, New Haven, Conn., Nov., 1884.*

LAST APPEARANCE OF THE BISON IN WEST VIRGINIA.—The following letter we owe to the kindness of Professor J. Packard of the Theological Seminary of Virginia. The facts regarding the last date of the appearance of the buffalo in West Virginia will be interesting in connection with the statements in J. A. Allen's work on the American bison, living and extinct.

PRINCETON, MERCER COUNTY, W. VA., April 26, 1877.

Your letter was received several days ago, and would have been answered before this, but was delayed by me with the hope of arriving at such information as some of the oldest of our citizens might be in possession of, which I expected to obtain at our last week's court. I have failed to get but little beyond the slight traditions I had before; to sum it all up, I think the last buffalo killed on Guyan river was killed by a man named Morgan, on a creek and at a lick called Buffalo, about four miles from its mouth that empties into said Guyan, and about fourteen miles from Logan C. H., and in the County of Logan, in the year 1804. Another one was killed, and perhaps the last one heard of, by Joseph Workman on the Deer Skin fork of Coal river, about the year 1810. This information I got from old Stephen Blankenship, who is now in his eighty-sixth year. I learn that old Mr. Workman is still living, and is ninety-five years old; the buffalo was killed in the present County of Boon, where he now lives. My impression was, before the receipt of your letter, that the last one

[1] Cope, E. D. The Phylogeny of the Camelidæ, Proc. Ac. Nat. Sci. Phil., 1875, p. 262.

[2] Report Expl. Surv. W. of 100th Mer. U. S. G. M. Wheeler in charge, IV, pt. 2, 1877.

was killed on Coal river, but think they did not remain in the State later than about 1805. A few elks lingered longer, perhaps as late as 1820. I think you might obtain, perhaps, the most accurate information in reach from Col. Benj. H. Smith (P. O. Charleston, Kanawha county, W. Va.), who is an intelligent old gentleman, and has practiced law in all the counties where the buffalo was seen last, he, I think, would likely remember the hunters' account of his departure from the State.

N. B. FRENCH.

ZOOLOGICAL NOTES.—*Worms.*—The despised earthworm appears, from a letter of Mr. F. E. Beddard to *Nature*, to be capable of attaining considerable dimensions. *Megascolex cæruleus*, said to be abundant after heavy showers in some parts of Great Britain, is represented in the British Museum by specimens more than two feet long. Two distinct genera of large sized earthworms, *Antæus* and *Titanus* Perrier, inhabit South America. The genus Acanthodrilus, from Western Africa, has two species which attain a length of three feet. An earthworm two to three feet long occurs in the interior of New Zealand, and a similar one in South Australia. But the largest known species is from South Africa. Forty years ago Rapp figured an earthworm six feet two inches long, obtained near Port Elizabeth, and recently Mr. Beddard procured a living example of the same species between four and five feet long and half an inch thick, from the same locality. It expands and contracts within wide limits, and may even be longer when fully expanded. Externally it resembles Lumbricus, in having four series of pairs of bristles on each segment, but its internal structure is quite distinct. This worm seems to be abundant, but is rarely seen, as it is only driven from its underground burrows by heavy and prolonged rains; on such occasions, which only occur a few times a year, the ground is covered by hundreds of these creatures, slowly crawling around until killed by the sun. A curious fact in connection with these worms is that the hard clayey soil in which they reside contains brackish water, thus proving that the presence of salt does not necessarily kill earthworms and their eggs, as has been supposed. The genus Pontodrilus Perrier lives among decaying seaweed cast up by the sea. ——Earthworms would appear to be exceedingly abundant in some parts of New Zealand, if we may judge from Mr. Urquhart's paper, in the transactions of the New Zealand Institute. The writer calculates that there are in one acre of pasture land near Auckland, 348,480 worms, with a weight of 612 pounds 9 oz.

Crustaceans.—In describing the head of *Palinurus lalandii*, Professor T. Jeffrey Parker divides the genus Palinurus into three sub-genera. Species in which the stridulating organ is absent, and the procephalic processes present are named Jasus; those with the stridulating organ and without the procephalic processes, Palin-

urus; while Gray's name, Panulirus, is retained for the longicorn species. All the species of Jasus (omitting *P. longimanus* and *P. frontalis*, of which no definite information could be obtained), are confined to the southern hemisphere, those of Palinurus to the northern, while those of Panulirus occur in both.

Fishes.—Mr. R. M. Johnston, in the Proc. Roy. Soc. of Tasmania, enumerates 188 known species of Tasmanian fishes. Of these about one-third are good edible fish, though only twenty-one are sufficiently abundant to be of importance. *Lates colonorum*, a well-known species in Australia, seems, in Tasmania, to be confined to one small river on the north-east of the island.

Mammals.—Mr. G. E. Dobson states that many of the most characteristic species of Australian Chiroptera have their nearest allies in the Ethiopian region. Thus Chalinolobus and the subgenus Mormopterus are South African and Australian. *Megaderma gigas*, of Queensland, has its nearest ally in *M. cor* from Eastern Africa, and Triænops, a remarkable leaf-nosed bat found in Madagascar, Eastern Africa, and Persia, has its nearest ally in the *Rhinonycteris aurantia* of Australia. Finally, Australia agrees much more closely with Madagascar, and the Mascarenes than with the oriental region, in the species of Pteropus, eighty per cent of which inhabit the Australian region and Madagascar, with its islands.——Mr. G. E. Dobson (Proc. Zöol. Soc., April, 1884) describes the myology and visceral anatomy of *Capromys melanurus*. The specimens on which the description is based were from the mountains of the southern end of Cuba, and appear to be the first of which the complete bodies preserved in spirit have reached Europe. The four known species of Capromys, *pilorides*, *brachyurus*, *prehensilis* and *melanurus* are confined, so far as known, to the islands of Cuba and Jamaica, where they are the only indigenous rodents. *C. brachyurus* is limited to Jamaica, the others to Cuba. The liver of this species differs remarkably from that of *C. pilorides*, in the absence of that sub-division of the hepatic lobes, which has been described in the latter species, and has been thought a generic character.——M. Testut (Bull. de la Soc. Zool. de France, VIII, 1883) has observed in twenty subjects the fusion of the flexor muscle of the thumb with the general flexor of the digits. As the presence of a separate muscle for the flexure of the thumb, causing that digit to be perfectly independent in its movements, is one of the characters made much of by those who wish to find a broad difference between man and the apes, it is significant to find this character so often absent. In three cases the two flexors were completely united into a single muscle. To meet with this character it is necessary to go back to the Cercopitheci, for in the anthropoid apes the muscles have a greater or less tendency to separation. In the gorilla, the flexor muscle divides into two parts, one of which goes to the thumb and first finger, the other to the re-

maining three fingers. This anomaly was found by M. Testut on both arms of one subject. In the orang, not only are the two deep flexors united, but there is no tendon for the thumb, and this abnormality has been observed in man by Gruber, Wagstaffe, Gegenbaur, and Chudzinski. M. Testut believes that he can trace the presternal muscle, which in three or four per cent of the human subjects that have been dissected is present, and is connected above with the sterno-mastoid tendon and below to the great oblique, to the condition of things which obtains in serpents (or rather in vertebrates deprived of a sternum) in which the great oblique is attached to the mastoid apophysis. The sterno-mastoid and great oblique muscles are identical in their position with regard to the tegument, their direction, and their insertion on the haemal axial line, but where a sternum is present, the muscular fibers which descend from the mastoid apophysis find insertions upon it and upon the clavicle, and the part intervening between these insertions and what is now the great oblique becomes atrophied. Muscular anomalies are frequent in man, but M. Testut, in an important work upon this subject, shows that the muscles subject to these anomalies, which disappear entirely in some, while in others they are abnormally developed, are muscles which play an unimportant part in the human economy, and are links which unite man to the lower animals.

EMBRYOLOGY.[1]

THE DEVELOPMENT OF THE RAYS OF OSSEOUS FISHES.[2]—Since the time when Vogt published his work on the development of the salmonoids, in 1842, it has been known that the earliest traces of rays to be noticed in the fin-folds of young fishes were fine, very numerous filaments, lying parallel to each other. Th. Lotz,[3] in 1864, carried Vogt's observations farther, and thought he showed that by the coalescence of these filaments the rudiments of the permanent rays were laid down. Both A. Agassiz and myself have found these filaments in the embryo of numerous widely separated genera of teleosts; the former having also pointed out their existence in Lepidosteus. They also exist permanently in an almost unmodified form in the Dipnoans, as shown by the researches of Günther and others. Balfour and myself have found these filaments in all of the fin-folds of Elasmobranchs, though they seem to be wanting in the more fleshy pectoral of some of the Rays. They are present in the fin-folds of embryo sturgeons, and there probably give rise to the permanent

[1] Edited by JOHN A. RYDER, Smithsonion Institution, Washington, D. C.

[2] Abstract of portion of a paper on the theory of the fins, to be published, with plates, in the Proc. U. S. Nat. Museum.

[3] Ueber die Schwanzwirbelsäule der Salmoniden, etc. Zeitsch. f. wiss. Zool., XIV, 2 Heft.

osseous rays as in Teleosts, but in very young Amphibians and Marsipobranchs they are absent, and in Amphioxus the development of the so-called rays at the bases of the vertical fins is so entirely different, according to Kowalevsky's account, that they are manifestly not homologous with the homogeneous embryonic radial filaments found in the fins of true fishes (Ganoids, Dipnoans, Teleosts, Elasmobranchs and Chimæroids).

In all the forms so far made the subjects of observation, these embryonic filaments are much more numerous than the permanent rays, and appear clearly defined in sections between the mesoblast and epiblast which constitute the fin-folds when the rays are being formed, these filaments then become covered externally by a more or less clearly defined layer of mesoblast about one cell deep, or, if they are not forced inwards in this way, they coalesce directly to form the basement membrane of the permanent rays. Usually, however, they are forced inward by the radial proliferation of the mesoblast spoken of above, and they then degenerate, their substance being apparently carried out to the surface of the mesoblastic core of the permanent rays by a process of metabolism to form the basement membrane of the latter which is crescentic in sections, and immediately overlaid externally by the integument. As this new formation takes place proximally it would appear that the primitive radial filaments had coalesced by their parallel sides distally, and fused into a continuous semi-tubular strip of basement membrane which maintains its more primitive fibrillated form distally or at the margin of the fin, thus giving rise to the dichotomous structure of the right and left halves of which a caudal fin-ray is almost always composed in osseous fishes.

The primitive radial fibers (=embryonic fin-rays of A. Agassiz) appear first at about the end of the lophocercal stage around the end of the tail and in the pectorals. In Gadus embryos, three weeks old, the first traces of these filaments appear at the end of the tail, in the vertical fold surrounding its extremity, as numerous elongated cells with fine protoplasmic prolongations extending in one direction toward the axis of the body and in the other away from it. These spindle cells are arranged like the filamentous rays which develop later, that is, their processes extend nearly parallel to the processes of those adjacent. These rudiments of the embryonic filaments bear a remarkable resemblance to cells found imbedded in the rays of Ceratodus, as figured by Günther in his memoir on that form. I will therefore call them *pterygoblasts;* their origin is mesoblastic and not epiblastic. They develop into the embryonic radial filaments, but the extent to which these are differentiated in the median fins of Teleosts is very variable. Amongst those forms which have continuous median fin-folds developed as well as a pre-anal fin-fold, Salmo is the only form known to me which has them developed through-

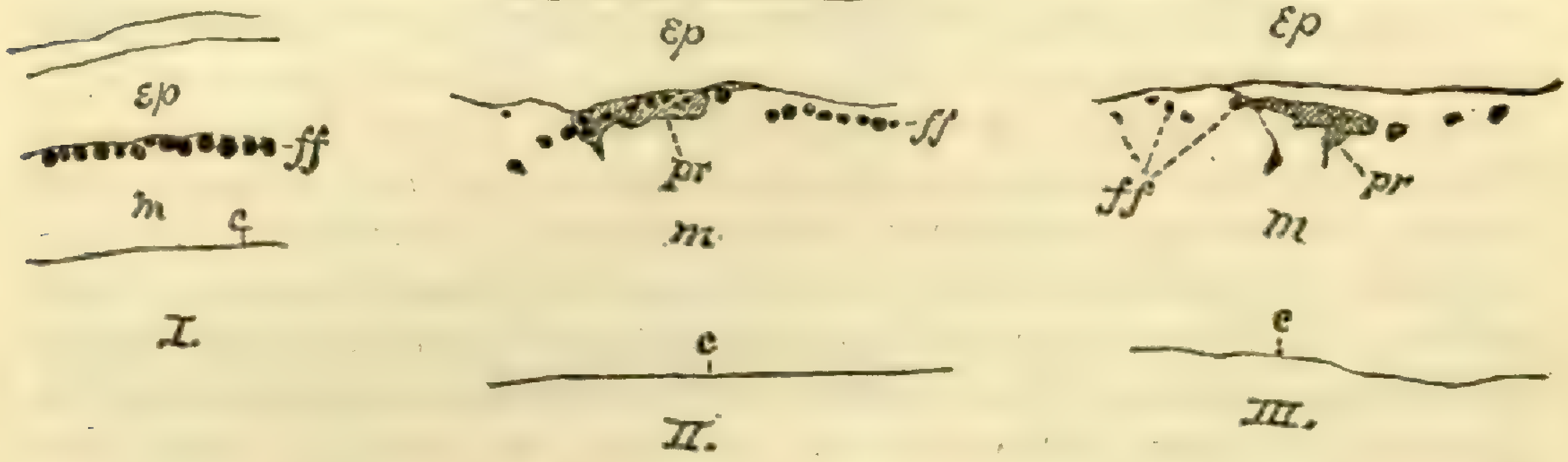
out the entire extent of those folds; Alosa, also a physostomous form, does not have them developed nearly so extensively at a corresponding period. In forms with discontinuous folds, as Siphostoma, for example, they are not very evident even at the time when the caudal rays are being formed, but aside from such exceptional forms they seem to be almost universally developed to some extent in the fin-folds of all truly fish-like forms except the lampreys and the lancelet.

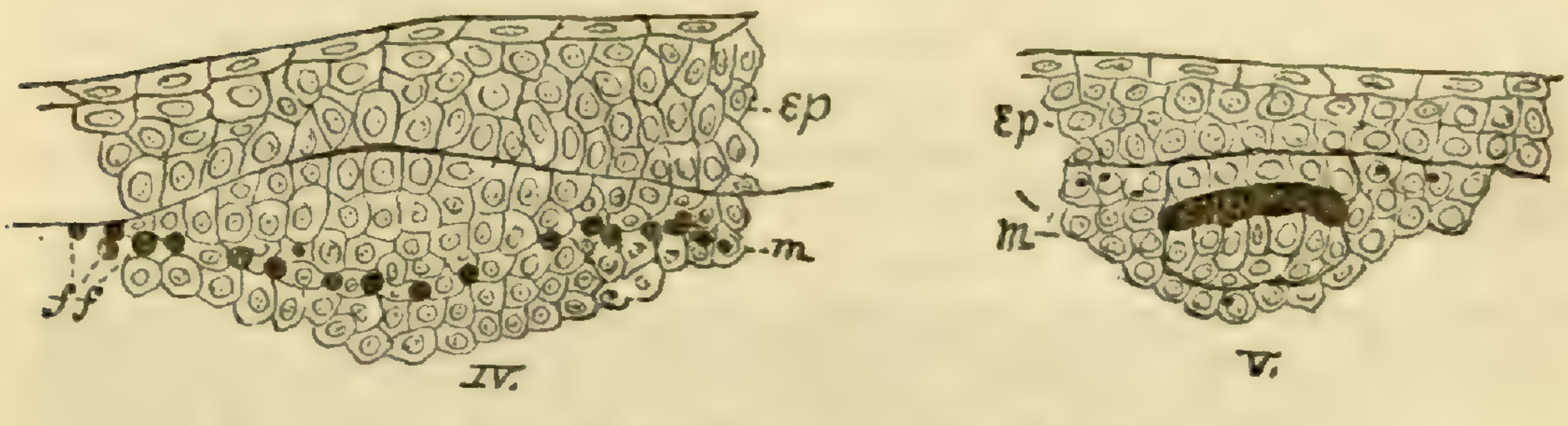
In consequence of the striking resemblance which this stage of the development of the rays of the most specialized fishes bears to what has remained nearly permanent, with but comparatively little modification in the Chimæroids, Elasmobranchs, Ceratodus and Protopterus, I propose to call this the *protopterygian stage* of the development of the fin rays in the Teleostei. The primitive fibers in section are shown to be perfectly cylindrical and homogeneous, and so far as histological tests enable me to judge, are perfectly similar in composition to the homogeneous semitubular matrix derived from the former, in which ossification occurs to form the permanent rays. Active metabolism evidently occurs at the base of the fin-folds about the time the permanent rays are in process of development, for the reason that after the stratum of fibers becomes covered externally by mesoblast in this situation they rapidly atrophy leaving nothing but the semitubular rudiments of the permanent rays, crescentic in section, which now lie between the epiblast and mesoblast resting upon thickened tracts of the latter internally and which radiate toward the margin of the permanent caudal fin-fold; the proximal ends of these mesoblastic cores rest upon the distal end of the upturned chorda.

The segmentation of the permanent rays has not been traced, but this evidently occurs before ossification has gone very far, as it is manifested quite early in the caudal rays of certain types. It is doubtless due in part to the bendings which the rays suffer while in *use*. The rudiments of these rays are imperfectly tubular in all forms, spines also having such a form at first, though frequently these have an external layer added by coalescence with dermal plates or denticles.

The main conclusion, therefore, at which I have arrived in this investigation is the following: that it is the mesoblast which is involved in giving origin to the fibrous embryonic rays and that that layer also effects their transformation into the rudiments of the permanent rays, and not the epiderm or embryonic integument, as heretofore generally held by anatomists. The whole history of the fin-folds in fact favors such a conclusion, since the horny fibers develop between the corium and epidermis or embryonic skin, in the plane of the *protomorphic* line of Huxley. The fin-folds of embryo fishes, it should be borne in mind also, are at first wholly epidermic, the corium or true skin being only developed during the later-larval or post-larval life.

During my observations on the development of Gadus, made in 1881, I noticed a space which exists between the skin and muscle-plates (see Pl. x, Figs. 43 and 44, Contrib. Embryog. of Osseous Fishes), since then Carlo Emery[1] has published his observations founded on a study of transverse sections of the tails of





EXPLANATION OF FIGURES.

Portions of vertical transverse sections of the caudal fin of a salmon embryo, showing the development of the halves of the permanent rays of one side.

FIG. 1.—*ep*, deep and superficial layer of epiblast; *m*, mesoblast; *c*, center of mesoblastic tissue proliferated into the dermal tail fold; *ff*, filamentous embryonic fin rays cut transversely near the margin of the caudal fold.

" 2.—From a section nearer the base of the fin to show the process of fusion of the primitive rays, *pr*. The other letters as before.

" 3.—From a section in which the rudiment of the permanent ray, *pr*, is covered by mesoblast, the filamentous rays, *ff*, having been still more thickly enveloped on the outer or epiblastic side by the mesoblast than in Fig. 2. Traces of the presence of the filamentous embryonic rays can be seen in the substance of *pr* in this and the foregoing figure.

" 4.—From a section through an outer caudal ray near its base, showing the fibers *ff* enveloped externally by the mesoblastic core of the permanent ray, which forms a swelling which is cut across, on the top of which the first traces of the proximal end of the permanent ray appears.

" 5.—Section through the basal part of a median ray, the primitive fibers in the vicinity having nearly disappeared, the ray itself again becoming covered externally by proliferated mesoblast. All of the figures enlarged 365 times, the cells being shown only in the two last.

embryos of Fierasfer, Belone and Lophius, in the early lophocercal stage. In these he finds a homogeneous secretion interposed between the muscle-plates and the epiblast, extending also into

[1] Sulla existenza del cosidetto tessuto di secrezione nei vertebrati. Att. R. Accad. Sci., Torino, XVIII, 1883.

the fin-folds, beside some scattering stellate mesoblastic cells which very possibly may be the pterygoblasts, which either themselves give rise to the embryonic rays or are indirectly concerned, together with the surrounding tissues, in pouring out such a homogeneous secretion. Such homogeneous substances I have found in other cavities in embryos, especially in the brain; in such cases I have been inclined to attribute their presence to the action of reagents, as extractive matters, as homogeneous, hardened acid-albumen, in short. The early advent of mesoblast into the fin-folds is at any rate a settled point, the stellate cells which wander outwards being mesenchymal, according to the terminology of the Hertwigs. In embryos of Scomberomorus I do not find the secretion noticed by Emery, homogeneous during the lophocercal condition, but loosely granular, more like the fine plasmic corpuscles found by me between the vitellus and zona radiata of the egg of Amiurus. At any rate I am not inclined to believe, after weighing the foregoing facts, that there is the slightest ground for the assumption that the fin-rays of fishes originate from the primary epiderm or larval integument, but that they arise from the mesoblast, as their position and first vascular supply would indicate. The distinction between the fin-rays as *exoskeletal*, from the other bones as *endoskeletal*, therefore breaks down on embryological grounds; for both are clearly of mesoblastic origin, as is further proven by the mode in which the insertions of the muscles which move the fin-rays originate.—*John A. Ryder.*

PSYCHOLOGY.

Dogs as Newspaper Carriers.—A very common thing on all the Connecticut railroad lines is for accommodating train men to throw newspapers off the trains at or near the houses of subscribers living on the line of the road at a distance from the stations. In many instances dogs have been trained to watch for the cars and get these papers, and country dogs, it is noticed, take quite an active interest in the affair. Over on the Naugatuck road some one has had the curiosity to inquire into this matter of dog messengers. Mr. Philip McLean, proprietor of the Gate House, on the Thomaston road, has a dog who goes a mile and a half every morning to meet the train. The paper was formerly thrown off by the brakeman on the last car, and there the dog watched for it. Lately it has been thrown from the baggage car. The dog appeared angry at the change, barked furiously, and waited sullenly for some time before going on his errand. He has not yet become reconciled to the new way of delivering his paper. Below Derby a dog has acted for several years as newsboy for a number of families. The papers are thrown out of the cars under full speed. Whether one or a large bundle of them, the dog is able to lug them off, making good time back. Another dog who has become a veteran as newsboy and cannot now, from age and rheu-

matism, get down to the cars, has in some way managed to train a younger dog to do his work. Edward Osborne, residing below Naugatuck, has a dog who regularly meets the early morning train. The house is a mile away from the railroad, and the dog never leaves on his errand until he hears the train whistle at Beacon Falls station. Then he starts on a run and waits at the same spot always, with his nose poked between the palings of a fence and his keen eyes watching for the flying paper. A story is told of one dog that was first taught to bring a certain New Haven paper, and when his master changed to another could not be induced to carry the new one. This is unlikely. Another story is that the late Senator William Brown, of Waterbury, had a pet dog that could readily distinguish the whistles of the New England engines from those of the Naugatuck, though running on a parallel track at the same time side by side. The faithful dog always found his train and car, and stood in waiting for the Hartford *Times*, which he carried home to his master for many years.—*Hartford (Conn.) Times.*

Hearing and Smell in Ants.[1]—In the investigation of the senses of the lower animals, especially of invertebrates, the best efforts of the student are often rendered inconclusive from the fact that, for aught we know, the sense-organs possessed by them may respond to vibrations which produce no effect upon us, and thus they may possess senses of which we have no idea, though they may lack what we can identify as hearing, taste, or smell. So long as a creature possesses eyes, we feel sure that it sees, though we may know that its perceptions are very limited; but it will not do to say that an animal cannot hear, only because it cannot hear sounds audible to us. For this reason Sir J. Lubbock carefully guards himself from the assertion that ants cannot hear; although all attempts to induce them to take notice of sounds audible to us proved failures. Not content with trying the most intense and the most acute sounds upon a colony of ants, and also upon single ants, he endeavored to ascertain whether ants could produce sounds intelligible to themselves, though inaudible to us. To this end he placed some honey upon one of six small pillars of wood set upon a board frequented by the members of a domesticated colony of *Lasius flavus*. Three ants were placed at the honey, and then imprisoned near it; then three others, which were also imprisoned. Numerous ants were moving round the board in search of food, and Sir J. Lubbock reasoned that if ants can make any sound intelligible to other ants, the imprisoned ants would tell the searchers of the food. On the first occasion only seven ants found the honey in three hours—no more than visited the pillars which had no honey. But when the ants which had eaten the honey were

[1] Résumé from the *Revue Scientifique*, of an extract from the work of Sir J. Lubbock, entitled Ants, Wasps and Bees, Experimental studies on the organism and habits of hymenopterous insects.

freed, fifty-four ants found the honey in half an hour. Other days of experiment resulted in the same manner. Thus it became evident that, if the imprisoned ants made sounds inaudible to us, those sounds had no meaning to their companions. A sensitive flame was not affected by anything the ants did, and a microphone, though it made their footsteps audible, gave no indication of any other sound. Remembering, however, that all vibrations between 35,000 per second, the highest perceived by the human ear, and 470,000,000 per second, which produce the sensation of red light, are only perceived by us as heat; and mindful also of the curious sense organs present upon the antennæ, Sir John Lubbock is still of opinion that ants have a sense cognate to what we call hearing. These antennal organs are of two kinds, one of which occurs in other insects, but the other seems to be peculiar to ants. The latter consist of an exterior and interior chamber, connected by a long narrow tube. A nerve ends in the interior chamber. The whole apparatus resembles a stethoscope, and Professor Tyndall and Sir J. Lubbock are of opinion that it serves for a similar purpose. Besides a group of these in the terminal segment of the antennæ, there are one or two in each succeeding segment. Moreover, ants have an apparatus consisting of several serrated ridges at the junction of some of the abdominal segments, and similar to an organ which in *Mutilla europæa* produces sounds audible to us. The inference is, that since Mutilla is not very distantly related to the ants, the apparatus possessed by the latter serves a purpose similar to that possessed by the former.

Experiments made upon the sense of smell showed that ants ear very sensitive to odors that produce the sensation of scent in us.

Psychical Research[1].—The Proceedings of the Society for Psychical Research are certainly remarkable amongst the literature of the present century and, rightly considered, are amongst the most interesting. The reports of the various committees are published primarily for the edification of the members, but they also court public criticism, and as a simple matter of fact they are worthy of all attention. It has been known for a long time that certain phenomena do occur amongst a certain class of persons which are, to say the least, inexplicable, for though it may be urged that collusion and connivance, conjuring and deceit, may be practiced occasionally, there is now a mass of trustworthy evidence demonstrating the truth of the hypothesis that thoughts are transferred from one person to another.

It must be conceded that until we can fully explain the mechanism of thought as found in any individual, that we have no right to say that it is impossible for one person to transfer his

[1] Proceedings of the Society for Psychical Research, Vol. I, Parts II and III. London, Trübner & Co.

thoughts to another; and to go further, we might say that until we can fully explain the phenomena of electricity we have no right to attempt to define the bounds of possibility in nature. Electricity has been known and utilized for years, but we are no nearer to a definite idea of what it really is than we were in the time of Volta and Galvani. There is ample material to enable us to form a good working hypothesis, and so also by a parity of reasoning there is quite sufficient to enable us to affirm that there is more in thought transference than those unacquainted with the phenomena have been willing to allow. In the second report of the committee on thought reading, or, more properly, thought transference, it is taken as established that "much of what is popularly known as 'thought reading' is in reality due to the interpretation by the so-called 'reader' of signs, consciously or unconsciously imparted by the touches, looks or gestures of those present, and that this is to be taken as the *prima facie* explanation whenever the thing thought of is not some visible or audible object, but some action or movement to be performed," and also that "there does exist a group of phenomena * * * which consist in the mental perception, by certain individuals at certain times, of a word or other object kept vividly before the mind of another person without any transmission of impression through the recognized channels of sense." The evidence the society is able to offer is fairly conclusive, and is certainly of such a character that it must be fairly met before its assumptions can be pooh-poohed in the orthodox manner.

Of the phenomena of dreams, chance coincidence, so-called apparitions, and what may be termed mental telephony, or telescopy, there is rather too much in the Proceedings, for there are so many authenticated cases that there is no reason to doubt that coincidences of the kind do occur; still, there is something weird in a case where a person saw others walking up the path towards the front door of her house at the very time they were drowned, and when we learn that the person actually ran to inform her friends that the others were coming up the garden, we can only conclude that there was some mistake, or that there was some actual transference of thought. The third report of the committee on thought transference contains the results of their experiments in a tabular form. Thus, with the trials to test the hypothesis of collusion, the actual results were one right guess in five and a quarter experiments (we give the totals only), while the chance of success by accident was only one in forty-three. In the series of experiments to test the hypothesis of chance coincidence, when the chances against success were fifty to one, upwards of forty per cent of the guesses were right, if the second and an occasional third response are admitted; but if the tests are confined to the first guess only the percentage is twenty-one, when, according to the laws of chance, the correct answers would

have been less than two per cent. The committee pertinently observe that their experiments derive much strength and coherence from their very multitude and variety; they have eliminated, as far as possible, the hypothesis of collusion, chance coincidence, and muscle or sign reading, and they are left with an accumulation of experiments which indicate clearly that thought transference is a possibility, or that there is some flaw in the evidence which they have been unable to discover. The third part of the Proceedings contains the first report of the committee on "mesmerism" and the first report of the Reichenbach committee, both of which will be found to contain a great deal more than is dreamt of in the philosophy of the ordinary world, though the committees respectively declare in the one case that they prefer to defer the publication of results, until a more complete reproduction of the experiments of others with added tests of their own have afforded a wider basis for discussion. The society has fairly established its demand for an inquiry by the scientific world, ever the most skeptical, and properly so, for it is the duty of science to reject everything that is not proven, while desirous, nay anxious, to take up any line of investigation that may lead to discoveries the ultimate result of which it cannot foresee.—*English Mechanic.*

ANTHROPOLOGY.[1]

THE PROTO-HELVETIANS.—The lowering of the levels of lakes Neuchatel and Bienne by the so-called "correction" of the Jura (a work undertaken for the prevention of floods) though it has by no means added to their beauty, is proving an immense gain to archæology. It has laid bare many Lacustrine stations, and rendered easy explorations which would otherwise have been impossible. Instead of the slow and often profitless process of dredging and picking up stray objects from between the piles at low water, the shrinkage of the lakes has permitted systematic excavations to be made in their former beds, on grounds which the Swiss antiquaries call the *couche archèologique.* The results are surprising beyond measure; besides throwing a flood of light on the history, the habits, and the civilization of the race of men who, thousands of years before the Christian era, made their homes on the lakes of Central Europe, and to whom has been given the apt name of Proto-Helvetians, they serve to correct old theories and suggest new conclusions. An idea of the richness of the finds made during the last ten years may be formed from the fact that the number of relics brought to light on lakes Bienne and Neuchatel since 1873, amounts to 19,599, of which 13,678 have been acquired by various Swiss museums. Nearly 6000 have been added to the collection of Dr. Goss, at Neuveville, on Lake Neuchatel, who has undertaken many explo-

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

rations at his own cost, and in whose presence some of the most valuable discoveries have been made. He now owns the richest private collection of Lacustrine relics in existence, and at the request of many brother antiquaries, he has published thirty-three phototype plates, reproduced from photographs taken by himself, of his more important finds. The number of the objects depicted is nearly 1000, and being fac-similies of the originals, and half, and in some instances three-fifths, of the natural size, the illustrations, elucidated by the doctor's suggestive comments, are almost as interesting and instructive as a visit to the collection at Neuveville, according to Professor Morel, of Morges, a high authority, the most valuable, if not the largest, known to archæology.

Notwithstanding the doubts that have been expressed to the contrary, Dr. Goss holds to the theory of three ages, an age of stone, an age of bronze, and an age of iron, a theory to which every new discovery lends additional confirmation. There are Swiss lake dwellings where not a vestige of metal has been met with. There are others in which a few tools or arms of pure copper, and, exceptionally, of bronze are found. It is therefore a safe inference, as it is antecedently probable, that the use of copper preceded the use of bronze. In other stations, again, bronze preponderates and stone disappears. Last of all comes iron, first as a precious metal, ornamenting and encrusting the bronze which in the end it was destined to replace. A noteworthy fact is the comparative rareness of ruined villages of the age of bronze. On Lake Bienne there have been found the vestiges of thirteen villages of the stone age, and two only of the age of bronze; but the latter are far the more extensive.

The stone age is marked by three distinct periods. A first period; primitive and poor, characterized by the rudeness of its implements, the coarseness of its pottery, and an entire absence of stones of an exotic origin. Of this period the best type is the station of Charamus, near Neuveville, on lake Neuchatel. In the second period, the art of working in stone has reached almost perfection. Implements and weapons are well designed and deftly executed; exotic stones are abundant, the pottery is well made and richly ornamented. The types of this age are the stations of Locras and Latrigin, on Lake Bienne. The third period is characterized by the appearance of metals. It is a period of transition. There is still the same plenty of stone tools and arms, the general character of Lacustrine civilization remains unaltered, yet implements of copper, though few and far between, and rudely made, foreshadow an approaching change. This period is represented by the village of Fenil, on Lake Bienne, and the station of Roseaux, on Morgès near Leman. Next comes *le bel âge du bronze*, with its great development of art, to be followed, after the lapse of untold ages, by the age of iron, and

that mysterious conflagration in which perished a civilization as old as that of Egypt, and as interesting as that of Hellas.

There is a marked difference between the habitations as between the implements, of the age of stone and the age of metals. The former, if more numerous, are less extensive; they were but from fifty to one hundred yards from the shore; the piles which formed their foundations are short, and made generally of entire trunks of trees. Between the piles are found fragments of stag's horns, broken stones, pieces of rude pottery, and bones of animals. The stations of the age of bronze, on the contrary, were large villages, built at a distance of from 200 to 300 yards from the shore, on large, long, and often squared piles, between which are found remnants of fine pottery, and often entire vases. It is lower down, under the mud which has accumulated about the piles, that the great finds have been made. One of the most remarkable stations is the recently discovered village of Fenil. Although the exploration is not yet completed, more than thirty articles in pure copper have already been found, and as similar relics have lately come to light at Greng, on lake Thorat, at Peschiera, on Lake Garda, and in other places, antiquaries may ere long deem it expedient to add to the three recognized ages an age of copper.

The minute and systematic researches which have been made on the shores of Swiss lakes, albeit they have brought to light such a multitude of priceless relics, have not yet resulted in the discovery of a single Lacustrine habitation. A few charred planks and beams showing that they were destroyed by fire, are all that remain. Fortunately, however, we are not without light on the subject. A short time ago there was discovered in a marsh at Schussenried, in Wurtemburg, a well-preserved hut of the age of stone. The flooring and a part of the walls were intact, and, as appeared from a careful measurement, had formed, when complete, a rectangle, ten meters long and seven meters wide. The hut was divided into two compartments, communicating with each other by a foot-bridge, made of three girders. A single door looking toward the south, was a meter wide, and opened into a room 6.50 meters long and four meters wide. In one corner lay a heap of stones which had apparently formed the fireplace. This room was the kitchen, "the living room," and probably a night refuge for the cattle in cold weather. The second room, which had no opening outside, measured 6.50 meters long and five meters wide, and was no doubt used as the family bed-chamber. The floors of both rooms were formed of sound logs, and the walls of split logs. This, be it remembered, was a hut of the stone age. It may be safely presumed that the dwellings of the bronze age were larger in size, and less primitive in their arrangements. At both periods the platform supporting the house communicated with the shore by means of a bridge (prob-

ably removable at pleasure) and with the water by ladders. These ladders, as appears from an example found at Chavannes, were made of a single stang with holes for the rungs, which protruded on either side.

The lake-dwellers, besides being carvers of stone, were workers in wood and skillful boat-builders. At Fenil and Chavannes have been found an ox yoke, fragments of tables, benches and doors, toy boats, hammers and spades, most of which Dr. Goss has presented to the museum of Berne. One of the best preserved canoes yet discovered was found in the stone age station of Vingrare (Lake Bienne) nearly three feet under the mud. The material is oak, the form of the stern square, like that of boats of the present day, the bow is pointed and spear-shaped. Its length is thirty-one feet two and a half inches, and in width it varies from twenty-nine and a half inches to thirty-five and a half inches. In order to prevent warping, the canoe was repeatedly washed with hot linseed oil, and afterwards rubbed with sand and wax, to fill up the interstices, by which means it has been kept in its original shape. With smaller objects of wood the same end is served by keeping them several weeks in alcohol or glycerine. Yew, however, is an exception; its durability exceeds that of oak; articles made from it show no signs of decay, and dry without warping.—[*To be continued.*]

The Antiquity of Man.—Professor Frederick W. Putnam, Curator of the Peabody Museum of American Archæology at Cambridge, made a few remarks at the semi-annual meeting of the American Antiquaries Society, bearing on the antiquity of man in America, based upon objects recently received at the museum.

He presented photographs of four blocks of tufa, each containing the imprint of a human foot. These blocks were cut from a bed of tufa sixteen feet from the surface, near the shore of Lake Managua, in Nicaragua, and were obtained by Dr. Earl Flint, who has been for several years investigating the archæology of Nicaragua for the museum, and has forwarded many important collections from the old burial mounds and shell heaps of that country. The volcanic materials above the foot-prints probably represent several distinct volcanic eruptions followed by deposits of silt. In one bed, apparently of clay and volcanic-ash, six and one-half feet above the foot-prints, many fossil leaves were found. Specimens of these are now in the museum, and their specific determination is awaited for with interest. While there can be no doubt of a great antiquity for these foot-prints, only a careful geological examination of the locality and a study of the fossils in the superimposed beds will determine whether that antiquity is to be counted by centuries or by geological time.

He also exhibited a portion of the right side of a human under-

jaw, which was found by Dr. C. C. Abbott in place in the gravel, fourteen feet from the surface, at the railroad cut near the station at Trenton, New Jersey. It will be remembered that in this same gravel deposit Dr. Abbott has found numerous rudely made implements of stone, and that in 1882 he found a human tooth, about twelve feet from the surface, not far from the spot where, as he states, the fragment of jaw was discovered on April 18, 1884. Both the tooth and piece of jaw are in the Peabody Museum, and they are much worn as if by attrition in the gravel, That they are as old as the gravel deposit itself there seems to be no doubt, whatever age geologists may assign to it, and they were apparently deposited under the same conditions as the mastodon tusk which was found several years since not far from where the human remains were discovered. While there is no doubt as to the human origin of the chipped stone implements which have been found in the Trenton gravel, a discovery to which archæology is indebted to Dr. Abbott, the fortunate finding of these fragments of the human skeleton add to the evidence which Dr. Abbott has obtained in relation to the existence of man previous to the formation of the great Trenton gravel deposit.

The discoveries announced in Professor Putnam's note are of the utmost importance, and they could not have fallen into more cautious hands. There is no doubt that Dr. Flint is an enthusiast on the antiquity of man in Central America. In a recent volume of the Smithsonian Annual Report, he is said to have found a cave that had been filled, after its formation, by tertiary sandstone. Now, on the removal of a portion of this sandstone, carvings, rock inscriptions were found on the walls of the cave, showing that man had arrived at the stage of rock carving in Central America before the deposits of tertiary sandstone. It is a pity that this cave cannot be visited by Professor Putnam.

Dr. Abbott's discovery, on the other hand, is simply in a line with his other finds. If man's works exist in the Trenton gravels, there is no improbability that man's remains will be found there. Wisely has Dr. Abbott yielded his own geological notions concerning his finds to the judgment of those who have studied systematically the Delaware basin.

ITINERANT ANTHROPOLOGY.—A new event in the history of anthropology in our country is the decision of Professor Baird to participate in the great State fairs. and notably in the cotton exposition at New Orleans. A system of glass knock-down cases has been devised, so that the objects may be mounted in the museum and shipped safely. On arriving at their destination the cases can be set up by two or three workmen in a day or two. The recent appropriation of Congress for the New Orleans exhibit was so amended as to include Cincinnati and Louisville. The brief space allowed for preparation necessarily made the

number of cases at the two latter cities rather small, but the choice made was a good one. Three areas of aboriginal life were admirably portrayed, Alaska, Queen Charlotte islands, and New Mexico. In cases running parallel, Eskimo and Haida life were set one against the other, to bring before the eye the fact that in close proximities the tribes of men are powerfully influenced by their environment. The preparation for New Orleans will be on a much larger scale. Professor Otis T. Mason, who has recently been appointed curator of ethnology in the National Museum, will have charge of these migratory anthropological exhibitions and wishes to make them as educational as possible.

SECTION OF ANTHROPOLOGY AT TURIN.—At the Esposizione Generale Italiana in Torino, 1884, the section of anthropology was organized with much care and included a wide treatment of the subject. The following scheme will give some idea of the method of installation:

CLASS I.

Methods and Processes employed in the Anthropologic Sciences.

Category 1. Instruments and apparatus of anthropometry.
" 2. Instruments and apparatus of craniometry and pelvimetry.
" 3. Measures of muscular force, dynamometry.
" 4. Measures of vital capacity, spirometry, spirography, thoracometry.
" 5. Measures of sensibility, æsthesiometry.
" 6. Measures of experimental psychology, reaction, reflex action, &c.
" 7. Measures of temperature, pulse and respiration, thermometry, sphygmography, pneumography.
" 8. Methods of weighing the brain.
" 9. Processes of mounting and preserving crania and skeletons.
" 10. Methods of preserving brains and other soft parts.
" 11. Cranio-cerebral topography.
" 12. Chromatic tables for the hair, skin and iris.
" 13. Methods of obtaining indices and means.
" 14. Anthropologic instruction in Italy.
" 15. Catalogues, plans and documents of Italian museums, public and private.
" 16. Special exhibition of Societa d'Anthropologia, Etnologia e Psicologia comparata.

CLASS II.

Comparative and General Anthropology.

Category 1. Physical characters of the anthropomorphous apes.
" 2. Human and comparative embryogeny.
" 3. Physical characters of the races of man.
" 4. Rudimentary and atavic characteristics.

CLASS III.

Anatomical Anthropology.

Category 1. Collections of typical Italian skulls.
" 2. Collections of typical Italian skeletons.

Category 3. Collections of male and female Italian pelves.
" 4. Collections of typical Italian brains.
" 5. Preparations showing the development of the skeleton.
" 6. Anthropological models and casts.

CLASS IV.

Anthropo-biology and Ethnology.

Category 1. Normal development in height, weight, strength, vitality.
" 2. Puberty and menstruation among Italian women.
" 3. Refraction in the eye in relation with skull-form, schools, sex, &c.
" 4. Physiologic and anthropometric studies upon Italians.
" 5. Distribution of color in the hair and eyes of Italians.
" 6. Expression and physiognomy of the Italians.
" 7. Acclimation of Italians in foreign countries.
" 8. Acclimation of non-Italian peoples in Italy.
" 9. Anthropology of Sardinia.

CLASS V.

Pathological Anthropology.

Category 1. Anomalies in the development of the human body.
" 2. Cranial pathology.
" 3. The delinquent classes in Italy.
" 4. The insane in Italy.
" 5. The defective classes.

CLASS VI.

Prehistoric and Palæoethnic Anthropology.

Category 1. Geologic time. The Tertiary.
" 2. " " The Quaternary.
" 3. " " Recent period, palæolithic, neolithic and bronze.

CLASS VII.

Ethnography.

Category 1. Clothing characteristic of different parts of Italy.
" 2. Ornaments.
" 3. Accessories of dress.
" 4. Tattooing.
" 5. Habitations in model and design.
" 6. Characteristic furniture.
" 7. Pottery.
" 8. Textiles.
" 9. Primary industries (taking the gifts of nature).
" 10. Receptacles of every kind.
" 11. Land transportation.
" 12. Water transportation.
" 13. Religion, superstitions, legends *et similia*.
" 14. Feasts, fêtes, carnivals.
" 15. Music.
" 16. Popular dances.
" 17. Songs, books and prints relating to literature and popular superstition.
" 18. Italian ethnography.

Class VII, in our scheme, would be termed Technography.

MICROSCOPY.[1]

CALDWELL'S AUTOMATIC MICROTOME.[2]—This machine has been devised to save labor to the histologist by cutting a very great number of sections suitable for microscopic investigation in a very short time. The machine is worked by hand and may easily be made to deliver in one continuous band, accurately cut sections at the rate of 100 per minute. To use it, however, to the best advantage, it is well to drive it by means of some motor, the fly-wheel being already provided with a groove for the reception of the cord coming from the motor. Where there is sufficient pressure and supply of water, a simple form of water motor seems the most appropriate and least expensive.

Method of using the Microtome.—Place one of the cylindrical vessels supplied with the machine upon a piece of paper on a glass plate, and pour into it sufficient melted paraffine to fill it. As this cools the paraffine will contract, and will leave a hole, which must be filled up with more melted paraffine.

Melt a small quantity, say an ounce, of imbedding material in some suitable vessel; a small copper pan or a porcelain crucible answers very well, if care is taken not to allow it to become hotter than is sufficient to thoroughly melt it. Take a piece of glass and smear it with a very small quantity of glycerine, to prevent the imbedding material from sticking to it. Then pour the melted material on the glass in small quantities at a time, so as to get a layer nearly a quarter of an inch thick. This when cut up into suitable pieces with a knife does very well for imbedding small objects. If larger objects are required, it is well to have two pieces of brass of the form shewn in Fig. 5, which, when placed together, will form a cavity half an inch in depth and of any desired length up to an inch or more; this cavity may be filled with the melted material in the manner already described, and the object to be cut must then be placed in position while the material is fluid. *It is well to cool the material as rapidly as possible by placing it in water as soon as it is sufficiently set.* From the cake thus formed, or from the piece cast in the mold, cut the piece of the material containing the object, and with an old scalpel, heated in a Bunsen flame, melt a small hole in the paraffine contained in the cylindrical vessel (Fig. 1 *a*), and insert the piece of imbedding material containing the imbedded object; then with the heated scalpel melt a little of the paraffine round the base of the projecting piece, so as to give it firm support, and allow this to become thoroughly set.

Now remove the large brass plate from the top of the microtome (Fig. 1 *b*) and insert the vessel containing the imbedded object in the tube for its reception, having first oiled the tube

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

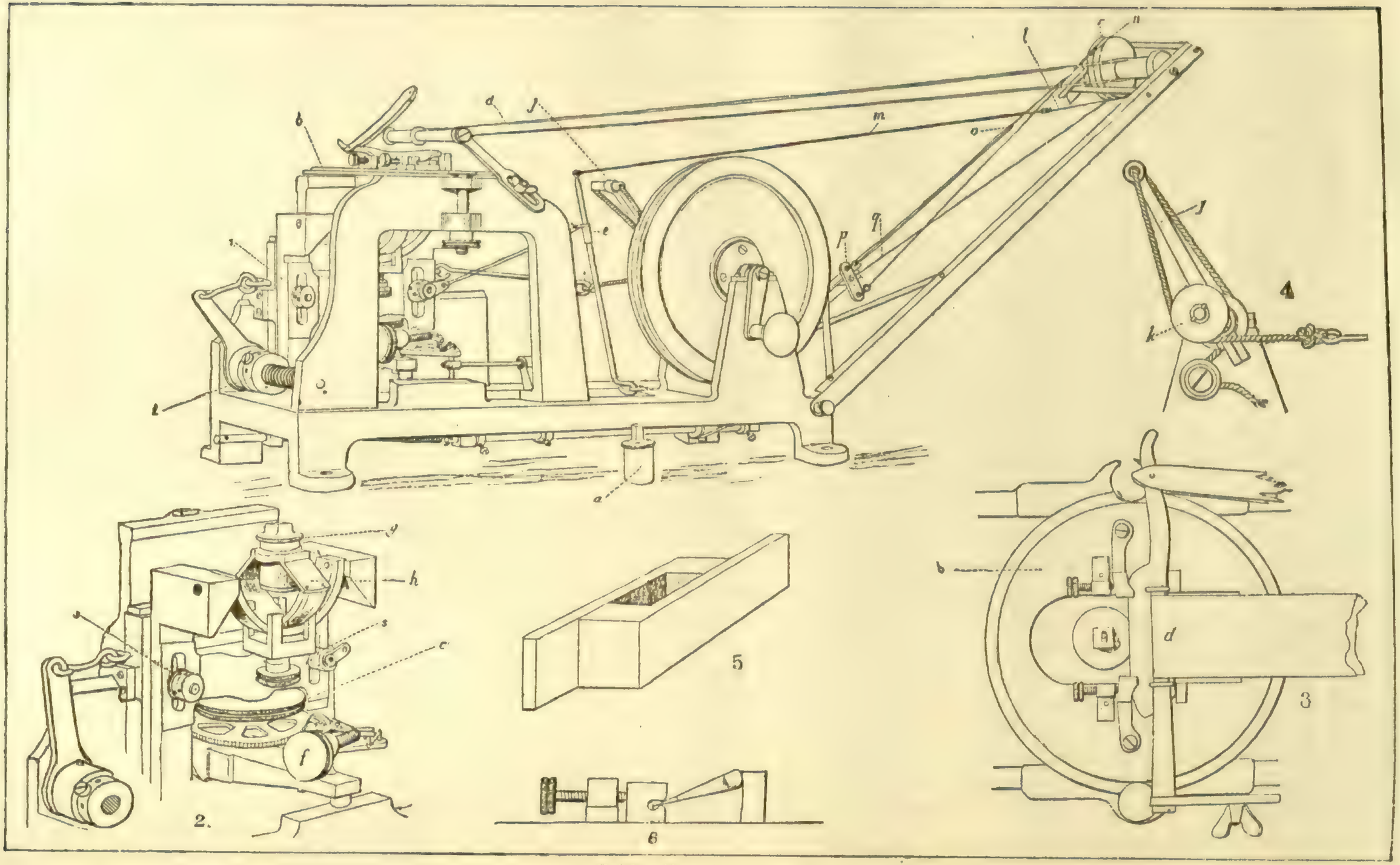
[2] *Quart. Jour. Micr. Sc.*, XXIV, Oct., 1884, p. 648.

slightly to prevent the vessel from sticking. Next with a sharp knife *cut the material with the object imbedded in it, so that all its opposite sides are parallel.* This is extremely important. Replace the top plate and fix the razor in the holder provided for the purpose. The clamp is so made that if a little care is taken the edge of the razor will not be injured (Fig. 6). The razor must be set so that its back is as high as possible, as shewn in Fig. 6, and above all *the razor must be extremely sharp. It should be sharpened on a stone and not on a strop.* The sharpness of the razor and the accurate parallelism of the sides of the mass to be cut are the most important points in the whole process.[1] Underneath the frame containing the object is a large brass milled head (Fig. 2 *c*). By turning this the object may be raised or lowered according to the direction in which it is turned. This should be done until the object is just below the edge of the razor. The plate holding the razor should then be moved so that the edge of the razor is close to and quite parallel with the mass of material to be cut[2] (Fig. 3). The plate should then be clamped by the screws at each side of it. A few turns of the fly-wheel will now bring the razor in contact with the object to be cut. The band of black ribbon (Figs. 1 and 3 *d*) is now to be placed so that the end of it should be just above the razor and clamped in that position. When the handle is turned the sections should come off the razor in the form of a ribbon.

The ribbon of sections will not find its way to the continuous black band without assistance. With a needle in a handle or with the point of a scalpel pick up the end of the ribbon, when a sufficient length of it has been cut, and place it on the black continuous band, up which it will travel. When it reaches the top of the band suitable lengths may be cut off with a pair of scissors. It may be found that the black band travels either too slowly or too fast. Its speed may be varied by moving the ring (Fig. 1 *e*) up or down upon the vertical brass arm—upwards if it is moving too fast, downwards if too slow. A frequent cause of failure in the proper movement of the band is, that the ebonite roller at the bottom of it is allowed to press against the razor; this must be avoided.

[1] The makers of the instrument have nearly completed an automatic machine for sharpening razors, since it has occurred to them that this is an operation which may be performed with much greater accuracy by mechanical means than by hand.

[2] The distance through which the sliding stage moves can be altered by raising or lowering the arm (Figs. 1 and 4 *j*). This distance should be so arranged that the surface of the imbedding mass containing the object to be cut just clears the razor when the sliding carriage is at its maximum and minimum distance from either end of the machine. This is important as the speed with which the black band travels varies directly with the throw of the machine. If this adjustment is made and a little care is used in adjusting the ring (Fig. 1 *e*), see below, the ribbon will move at each turn of the fly-wheel through a distance equal to the breadth of the surface which is being cut. If, on the other hand, the object swings far beyond the razor, the band will travel too quickly and probably break the string of sections.



Caldwell's Automatic Microtome.

Varying the thickness of the sections.—In Fig. 2 will be seen a milled head, *f*, which, when turned, controls the movement of the clicks which, acting upon the ratchet wheel attached to the micrometer screw, regulate the thickness of the sections. This may be done so as to allow the clicks to engage one-half, one or several teeth of the ratchet wheel as may be required. When arranged for one half tooth, the sections will be $\frac{1}{10000}$ of an inch (.0025^{mm}) in thickness, when arranged to engage a whole tooth $\frac{1}{5000}$ of an inch (.005^{mm}) and so on. At first it is well to use a whole tooth, as when thinner sections are cut so much depends on the sharpness of the razor. After cutting for some time the machine will suddenly stop, the object ceasing to rise when the handle is turned. This means that the full extent of the micrometer screw has been reached. It is necessary then to turn the large milled head (Fig. 2 *c*) downwards, which will allow the carriage containing the object to fall to its lowest limit. It will be necessary now to raise the socket (Fig. 2 *g*) in which the object is held so as to be in position to come in contact with the razor. This milled head (Fig. 2 *c*) is useful for rapidly getting the object in proper position and avoiding considerable loss of time in turning the handle. The frame (Fig. 2 *h*) which holds the socket is arranged with two quadrants, so that the socket may be set at any angle desired, and may be clamped with the milled head underneath it. This is for use when the object has not been symmetrically imbedded. The nut (Fig. 1 *i*) is for tightening up the spring which draws the carriage of the machine back after having been pulled forward. In case this does not work properly, it is only necessary to unloose the two screws and with some strong but blunt pieces of steel placed in the two holes, to rotate the nut so as to give a proper tension to the spiral spring. When this is done the screws should be tightened up again to keep the nut in place.

The lock nuts (Figs. 1 and 2 *s*) should be screwed up sufficiently tight to barely prevent the carriage from falling by its own weight, so that when the milled head (Fig. 2 *c*) is screwed down a slight pressure with the finger is necessary to make the carriage fall.

To arrange the machine for cutting different sized blocks of material, it is only necessary to raise or lower the arm (Figs. 1 and 4 *j*). When this arm is in a vertical position the machine is arranged for its maximum traverse. When turned to the right and placed horizontally it is at its minimum traverse. The cord, however, must always be in the groove of the wheel, *k*.

It is important to keep the strings which give motion to the endless band in proper position. The string (Fig. 1 *l*) should go from the end of the wire, *m*, round the groove, *n*, in the pulley and thence to the elastic band, *o*. The elastic band, *o*, should be stretched and placed over the hook attached to the arm, *p*, care

being taken that the shorter end of the arm, *p*, is uppermost. The string, *q*, should be tied to the stud upon which the arm, *p*, is supported, going thence round the groove, *r*, of the pulley, and back again to the hook at the longer and lower end of the arm, *p*, to which it should be tied.

Method of preparing the slide.—Make by the aid of heat a viscid solution of white shellac in light colored creosote. Spread a smooth, thin and even layer of this solution on a clean dry slide with a camel hair brush or with the little finger. Arrange the ribbon containing the sections on this slide while moist, and place it in the dry shelf of the water bath, which should be at a temperature slightly above the melting point of the imbedding material used. It should be left here until the creosote has evaporated and the imbedding material melted. Now allow the slide to cool, and then wash it with turpentine until all the imbedding material is dissolved. Canada balsam in chloroform or turpentine and the cover slip may now be applied in the usual manner. For convenience of mounting it is extremely important that the ribbon of sections should be quite straight, and in order to ensure this it is necessary that the sides of the imbedding material from which the sections are cut should be quite parallel. The straight ribbon, when obtained, should be removed to some clean surface and there cut into lengths appropriate to the size of the cover slips used. It will be found convenient to use cover slips at least two inches long; indeed, a useful length for slides and cover slips is six inches for the former and four inches for the latter.

A method of imbedding the specimen to be cut.—After the specimen has been stained it should be left in ninety per cent alcohol for a few minutes, and thence transferred to absolute alcohol, there to remain until all the water is extracted. The length of time necessary for this varies greatly with the size of the specimen. A three day chick, for instance, will require about an hour, larger specimens a day or more, in which case the absolute alcohol should be changed occasionally. Some tissues may be transferred directly from the absolute alcohol to turpentine, and thence in about two hours to the melted imbedding material. For delicate tissues, however, the following process, though longer and more troublesome, is greatly preferable. With a pipette introduce some chloroform to which two or three drops of ether have been added, under the alcohol in which the object is lying. The object will then float for some time at the junction of the alcohol and chloroform, and will finally sink into the chloroform when saturated with it. If, as often happens in the case of embryonic tissues, the object is lighter than the chloroform, it is not easy to tell when the saturation is complete, but generally on shaking the bottle a saturated tissue can be temporarily covered by the chlo-

roform, while tissues containing alcohol keep steadily on the surface.

When the tissue is saturated with the etherized cloroform it should be transferred to pure chloroform and there left for a few minutes. Then drop in some pellets of soft paraffine and leave it for two hours or more, shaking occasionally. The whole should then be poured into a small melting pot and a quantity of imbedding material added. The melting pot should then be placed in the water bath at a temperature of about 60° C., and there left until all the chloroform has evaporated, which may be determined by the absence of smell of chloroform on shaking. If much imbedding material is required this process takes a day or two; it is therefore better, when the solution of imbedding material is fairly strong, to take out the tissue and put it direct into pure melted imbedding material. In any case no chloroform must remain in the material to be cut, as it makes it brittle. Generally speaking the more gradually these processes are passed through the better will be the result.

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SCIENTIFIC NEWS.

— At a meeting of the Glasgow Philosophical Society in December, a paper was read by Professor W. Dittmar on the general results of his chemical work in connection with the Challenger expedition. Professor M'Kendrick commented on the paper, and said that the question of the breathing of marine animals was one of very great interest, and they could see at once that before it could be examined they must know something about the proportion of the gases dissolved in sea water. On that point they had been without accurate data up to the time of the very elaborate researches of which they had received an account that night. One fact which struck him as a physiologist as being most remarkable, was the very small quantity of oxygen in sea water, although it was yet sufficient for the respiration of fishes and other creatures living in the ocean. In point of fact blood was much richer in oxygen than sea water. It seemed to him that what they needed next was a careful analysis of the gases as they existed in the blood of fishes, more especially in that of some of those fishes which had been found at the depth of 2570 fathoms, living in a medium where the pressure on the square inch of the body must be something like three tons, because they had supposed that the problem of breathing depended to a considerable extent upon the law of pressures. It was well known that life could be maintained with a small quantity of oxygen in the event of carbonic acid being removed, and it was probable that in the case of those fishes, while the percentage of oxygen

was small, the carbonic acid would at once be taken up, so that it did not accumulate in the immediate vicinity of the breathing apparatus.—*English Mechanic.*

— In an address delivered lately at Preston, after distributing the prizes to the students of the Harris Institute, Professor Tyndall spoke of the three great discoveries which in after time will be regarded as the glory of the present age, vis: those of the conservation of energy, the principle of evolution, and the germ theory of disease. The germ theory of disease in its earliest glimmerings appeared centuries ago; but William Budd was the first to see further than his contemporaries, and his grand generalization has been confirmed by experiment. So long ago as 1817 Schwann demonstrated that putrifaction was the work of living organisms, and in 1863, Pasteur followed with his far more elaborate researches. A high tribute was paid to Koch's researches. The immunity enjoyed by the vaccinated, Tyndall accounts for on the supposition that contagia being living things, demand certain elements of life, and when those are exhausted they can no longer live. To exhaust a soil, then, a parasite less vigorous and destructive than its virulent representative may suffice, and once the soil is exhausted the virulent type is powerless to injure. Such in substance is the germ theory of disease.

— At the Newport meeting of the National Academy of Sciences, Mr. Fairman Rogers referred to Mr. Muybridge's experiments made last summer on the motions of animals by instantaneous photography. No especially new system is used, but the apparatus has been perfected in many details, and dry plates are used, so that superior results may be looked for. While many instantaneous photographs of animals in motion existed before those made by Muybridge, they were mere isolated attitudes of motion, giving very little information, while his, being consecutive, and taken at equal intervals of space or time, give all the information regarding the different phases of the motion. It is perfectly possible to apply this method to the study of all kinds of motion, and it must come into use for that purpose. It would be useful, for instance, to study in this way the propelling action of the tails of fishes, with a view of determining the proper form for screw propellers, which will not only give good results in economic propulsion, but will avoid the vibrations accompanying high speed.

— Professor Bickmore, of the American Museum of Natural History, will give a course of ten lectures for the benefit of such teachers in the public schools as are required to deliver object lessons upon botany and zoölogy. The first six lectures will be devoted to human physiology and anatomy. The lectures are all to be illustrated by stereoscopic views, and in order to make them

as widely useful as possible, a copy of each one, together with a set of the stereoscopic slides which were used for its illustration, will be sent to each normal school in the State. The series, which begins on October 18, is the commencement of a course of lectures which is to extend over four years, and be conducted in the same way and for the same object. The Legislature has appropriated $18,000 to defray the expenses of these lectures.

— A tidal wave burst into the harbor of New Haven, Conn., at 11 o'clock, Dec. 22. It is now believed that there must have been a convulsion of the earth in Long Island sound, directly off the harbor, or near by, for at quarter past eleven a tidal wave, crowned with foam and fully eight feet high, came rolling into the bay from the south, traversing the entire length of the harbor, which is four miles long. It had a speed of about twelve miles an hour, and moved with an ominous rushing sound, like the blast of a hurricane, carrying destruction in its path.

— The second Abtheilung, *Arthropoda*, of the Zoologischer Jahresbericht for 1883, was issued in November. It has been prepared by Drs. Paul Mayer and W. Giesbrecht, assisted by a corps of specialists. It is a most indispensable work to the zoölogist; and this part is very full in abstracts of and reference to the entomological literature of 1883. It is a product of the zoölogical station at Naples.

— The Johns Hopkins University circulars for December contain abstracts of essays on the following topics: On a new law of variation, by W. K. Brooks; Method of formation of the trochosphere in Serpula, by W. H. Conn; The gill in Neptunea, by H. L. Osborn; On the presence of an intracellular digestion in Salpa; On the structure and affinities of Phytoptus, by J. P. McMurrich.

— By the death of Robert Alfred Cloyne Godwin-Austen, F.R.S., geology loses one of its most distinguished students. Mr. Godwin-Austen was born in 1808, and died on Nov. 25th, at his residence near Guildford. He was associated with the late Edward Forbes in work on marine zoölogy, and edited and continued Forbes' Natural History of the European seas.

— The professors of the Philadelphia Academy of Natural Sciences have organized themselves as a faculty and elected Professor D. G. Brinton dean, and Professor Angelo Heilprin, secretary.

— At a December meeting of the London Western Microscopical Club Mr. F. Cheshire showed some beautiful specimens of bacilli which produce disease among bees.

— The deaths are announced of two renowned physiologists, viz: Professor von Vierordt, of Tübingen, and Professor von Wittich, of Königsberg.

— Dr. Thomas Wright, F.R.S., of Cheltenham, in whom geology and palæontology lose a distinguished student, died in December last.

— Professor D. S. Jordan has been appointed president of the University of Indiana, at Bloomington.

— Erratum: on p. 109, line 15, for *bogs* read *bays.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, May 29.—Mr. Ford announced the discovery of *Pholas truncata* in peat near Sea Isle city. Mr. Redfield said that he had found this species thirty years ago, closely packed in salt-water turf, near Rye, Long Island sound, and he believed the species might be found in similar locations all along the coast.

June 12.—Professor H. C. Lewis gave the results of his examination of dust from Krakatoa, taken from the rigging of the bark *William H. Besse.* By far the greater part is powdered glass, but crystals of transparent plagioclase, and irregular fragments of pyroxenic materials, probably augite and hypersthene, as well as grains of magnetite, occur. The dust does not at all resemble that described by Mr. Wharton, and collected in Philadelphia. The same speaker described a curious round, rock-like exposure of basalt at Blue Rock, Chester county, Pa.

June 19.—Professor Heilprin spoke of the great difference between the Foraminifera of the rotten limestone of Northeastern Mississippi and that of the ooze of the Gulf of Mexico. He also showed an example of *Calymene niagarensis,* taken from the Eocene above Vicksburg, but evidently washed down from the Silurian. Dr. McCook called attention to certain globular nodules of earth which were the cocoons of a tube-weaving spider of the genus Micaria. Spider cocoons, covered with scraped bark, old wood, etc., had been found before, but this was the first occasion in which a covering of mud had been found. The specimens were gathered upon fallen boards by Mr. F. M. Webster, assistant State entomologist of Illinois.

July 10.—Professor Heilprin showed the tail-piece of a trilobite found at the Delaware Water Gap. He proposed to name the species *Phacops broadheadii.* It is near *P. nasutus.* Its hori-

zon is the Stormville shales of the Lower Helderberg. Miss G. Lewis described a schizomycete found in a sulphur spring at Clifton Springs, N. Y. Mr. Meehan stated his belief that the fasciation of a branch was a premature attempt to form flowers.

July 17.—Professor Heilprin reported the discovery, in the Stormville shales, at the Delaware Water Gap, of the tooth of a Cestracion. Mr. Meehan exhibited specimens of the Western annual sunflower (*Helianthus lenticularis*), and spoke of the probability that it was the parent of the garden sunflower. A paper on the geology of Delaware was presented for publication by Professor F. D. Chester.

American Society for Psychical Research, Dec. 18.—To this meeting were invited all those who had accepted the invitation to join a psychical society, sent out by the committee of organization appointed by the meeting held in Boston, Sept. 23d. This committee consisted of G. Stanley Hall, E. C. Pickering, H. P. Bowditch, C. S. Minot, William Watson, S. H. Scudder, William James, Alpheus Hyatt, and N. D. C. Hodges. The meeting was called to order by Professor E. C. Pickering. Mr. S. H. Scudder was chosen chairman *pro tem.*, and Mr. N. D. C. Hodges secretary *pro tem.* Mr. Scudder told the history of the movement which had resulted in the formation of the society, giving in some detail an account of the work done by the committee, which had had full charge of the work of organization. The first business was the election of fifteen members of the council of twenty-one, which will have charge of the conduct of the society. G. Stanley Hall, George S. Fullerton, William James and E. C. Pickering, were elected for three years; Simon Newcourt, C. S. Minot, H. P. Bowditch and N. D. C. Hodges, for two years; and George F. Barker, S. H. Scudder, Rev. C. C. Everett, Moorfield Storey, Esq., John Trowbridge, William Watson and Alpheus Hyatt, for one year. The constitution provides that seven shall be elected each year, to hold office for three years.

The committee on work made an informal report, and has since issued a circular calling for volunteers to go on the investigation committees, and for information in regard to furnishing subjects for investigation. The society then adjourned to meet January 8th.

Biological Society of Washington, Dec. 13.—The following communications were made: Mr. Leonhard Stejneger on an exhibition of specimens illustrating the shedding of the bill in auks; Mr. George Vasey on the grasses of the arid plains; Mr. Charles D. Walcott, on the oldest known fauna on the American continent; Professor Lester F. Ward on the occurrence of the seventeen-year locust in Virginia in October, 1884. Additions to the Flora of Washington, made during 1884.

Dec. 27.—Mr. Frederick W. True on a new porpoise, *Phocæna dalli*, from Alaska; Mr. John A. Ryder on the development of the rays of fishes; Mr. John Murdoch on a collection of marine invertebrates obtained by Lieut. A. W. Greely, U. S. A.; Mr. G. Brown Goode on natural history at the New Orleans exhibition.

NEW YORK ACADEMY OF SCIENCES, Nov. 24.—The following paper was announced for the meeting: The glacial and pre-glacial drifts of Staten Island and New Jersey, by Dr. N. L. Britton; Mr. George F. Kunz exhibited and made brief remarks upon some gems and gem-minerals.

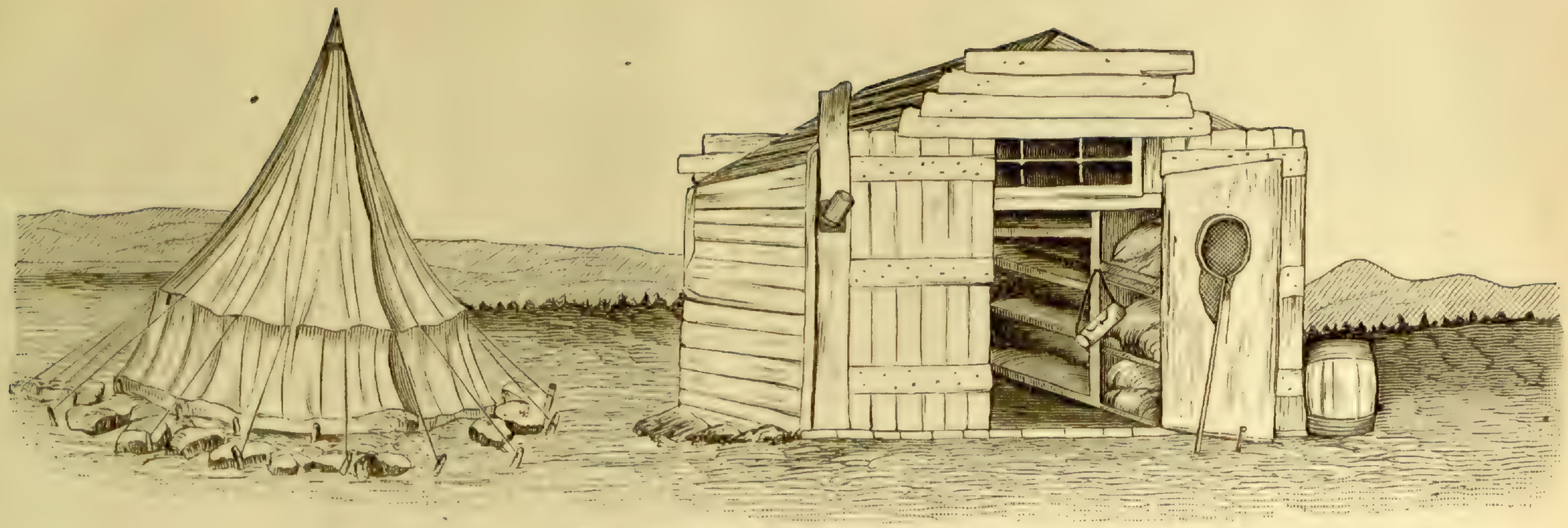
Dec. 15.—The food-plants and fiber-plants of the North American Indians (illustrated), by Professor J. S. Newberry.

AMERICAN GEOGRAPHICAL SOCIETY, Dec. 12.—Lieutenant Frederick Schwatka, U. S. Army, delivered a lecture, entitled Alaska, and exploration along the Yukon river. An account of the longest raft-journey in the world, illustrated with stereopticon views.

APPALACHIAN MOUNTAIN CLUB, Boston, Dec. 9.—Lieutenant Frederick Schwatka, U. S. A., read a paper on Alaska and the British Northwestern Territory.

Dec. 18.—After the routine business of the evening, those present were given the opportunity to enjoy an hour of social intercourse. A series of lantern views representing mountain scenery on the Pacific slope, presented to the club by Mrs. E. A. Lane, was also exhibited. Photographs now in the possession of the club were on exhibition, and members were invited to bring any photographs they may have of mountain scenery.

BOSTON SOCIETY OF NATURAL HISTORY, Dec. 17.—Dr. G. L. Goodale spoke of the continuity of protoplasm in certain vegetable tissues.



The Naturalists' Camp on "the Labrador."

THE

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INDIAN CORN AND THE INDIAN.

BY E. LEWIS STURTEVANT, M.D.

MAIZE is the product of an ancient American civilization, which if small as compared with that of to-day, yet was capable of achieving results which we of the present gladly appropriate. It constituted the daily food of tribes which have now disappeared from existence, and at the time of the discovery was a cherished plant throughout the temperate and the tropical regions of America, and finds mention in nearly every account of the voyager, or hardy explorer who penetrated beyond the confines of the coast. The plant has never been recorded as being found in a wild state, but has existed in numerous varieties from time immemorial, and the leading races grown to-day can find more or less certain identification in the imperfect descriptions of the species grown by the Indians.

It is a general observation that varieties are produced through the influence of the wants and the choice expressed by civilization, and hence we may conclude that the vast number of varieties of maize that formerly, as now, existed, have been derived through the appreciation of a culture that was under the influence of varied and critical consumers. In Central America the conditions existed for producing varieties, and hence wheresoever the home of the native plant is to be located, from this central region must we preferably look for the origin of the domesticated maize-plant, as we now know it, or at least of some of its races. We have evidence in the tropical nature of the plant that it was originally derived from a country where winters were unknown, or were mild. The few traditions that we have found recorded by the Indians all point towards Central America, as where it is

stated in the Popol Vuh that four barbarians, the Fox, the Jackal, the Paraquet and the Crow, guided to Paxil or Cayala, the "land of divided and stagnant waters" where "the white and the yellow maize did abound," and apparently a civilized country, and where the use of maize for meal and for preparing "nine drinks" was acquired. The Navajoes have the tradition that a turkey hen came to them flying from the direction of the morning star, and shook from her feathers an ear of blue corn (Bancroft, Native Races, III, 83). The Indians of Massachusetts, as Roger Williams writes, have a tradition that the crow brought "them at first an Indian graine of corne in one Eare, and an Indian or French Beane in another, from the great God Kautautowits' field in the Southwest, from whence they hold came all their Corne and Beanes" (Key to the Lang. of Am., 1643, p. 144, Narragansett Club ed.).

The antiquity of maize, as well as its importance, is attested by the circumstance of its connection with religion, and its acquirement of sacred characters. Centeotl, in Mexico, was goddess of maize, and hence of agriculture, and was known, according to Clavigero, by the title, among others, of Tonacajohua, "she who sustains us." Sahagrun writes of the seventy-eight chapels of the great temple at Mexico, that the forty-fifth edifice was called Cinteupan, and therein was a statue of the god of maize. Torquemada also says "there was another chapel dedicated to the god Cinteutl, called Cinteupan, he was the god of maize and of bread," and Charnay (1880), who quotes the above references, found a statue bearing sculptural representations of ears of maize.

The Mexican god Tlaloc is represented by Ixtlilxochitl "in the picture of the month Etzalli with a cane of maize in the one hand and in the other a kind of instrument with which he was digging the ground" (Bancroft, Native Races, III, 325), and various ceremonials in relation to maize are recorded by many of the early Spanish writers upon Mexico.

In Peru the maize of Titiaca was considered sacred, and was distributed throughout the kingdom in small parcels to impart a portion of its sanctity to the granary wherein it was stored (Garcilasso, Royal Com. Hak. Soc. ed., I, 288), and in the garden of the Inca: "There was also a large field of maize, the grain they call quinua, pulses, and fruit trees with their fruit; all made

of gold and silver" (*ib.*, I, 283). Acosta also describes ceremonies in which maize took part.

It seems certain that the Indians of America were often agricultural, especially under circumstances where the soil was favorable, and where tribal strength admitted of the protection of their crops, and that maize was cultivated not only sufficient for their own wants but also to admit of furnishing supplies to others in need. We think it well to bring together evidence to this effect connected with the northern portion of our country.

In the Icelandic Saga, in 1006, Karlsefne arrived at a place called Hop, at the mouth of a river, which may as well be the St. Lawrence as any other, as this seems to answer the conditions of the narrative, and "they found there upon the land self sown fields of wheat, there where the ground was low, but vines there where it rose somewhat" (Icelandic Sagas, Prince Soc. ed., p. 54), and "sent out two Scotch people to explore; when they returned they brought back a bunch of grapes, and a new sowen ear of wheat" (Voyages of the Northmen, Prince Soc. Pub., p. 51). "The same year (1002) [Rafn.], sailing from Greenland westward, Thorwald, brother of Lief, reached the wintering place in Vinland [mouth of the St. Lawrence]. The following summer * * * * on an island far westward 'met with a wooden Kornhjalmr,' but saw no other signs of inhabitants, nor of wild beasts" (Pickering Chron. Hist. of Pl., p. 664). In 1535, Jacques Cartier, at Hochelega, now Montreal [the island far westward?], "began to find goodly and large fields, full of such corn as the country yieldeth; it is even as the millet of Brazil, as great and somewhat bigger than small peason, wherewith they live even as we do, with ours" (Pinkerton's Coll. of Voy., XII, 651), and elsewhere he says: "At the top of the houses were garners where they kept their corn, which was something like the millet of Brazil, and called by them *Carracony* (Tytler's Disc. of N. Coast of Am., p. 46), and he further states that the town was situated in the midst of extensive corn fields and the houses were large and commodious (Cartier's Voy. Hak. Coll.). Another name for the corn seemed to have been *offici*, and he also adds: "They have also great store of musk-millons, pompions, gourds, cucumbers, peason and beans of every color, yet differing from ours" (Pinkerton's Voy., XII, 656). In 1613 Champlain found at Lake Coulonge, on the Ottawa river, a crop of maize growing (Park-

man, Pioneers of France, 348) in this northern latitude, and on the Ottawa river, 1632, mentions also pumpkins, beans and French peas obtained recently from the traders (*ib.*, 352).

This year on Lake Huron, Champlain saw fields of maize, idle pumpkins ripening in the sun, and patches of sunflowers (*ib.*, 366). "The Adirondacs," says Colden, "formerly lived 300 miles above Trois Rivers; * * * * at that time they employed themselves wholly in hunting, and the Five Nations made planting of corn their business (Hist. of the Five Nations, Lond., 1747).

In 1615 Champlain invaded the Iroquois country, the present New York, and saw the Iroquois at work among their pumpkins and maize, gathering their harvest, for it was the month of October. In 1653 Le Moyne navigated Lake Ontario, and in the country of the Senecas had given him "bread made from Indian corn, of a kind to be roasted at the fire." In 1687, in an invasion into this country by de Nouville, some 400,000 minots, or 1,200,000 bushels of corn were said to have been destroyed (Doc. Hist. of N. Y., 1, 238); and in 1696, Frontenac, in the country of the Onondagas, spent the 7th, 8th and 9th of August with his army in destroying the growing corn which extended from a league and a half to two leagues from the fort (*ib.*, 1, 212). In 1779, when the army under Gen. Sullivan came to the vicinity of Cayuga and Seneca lakes, they found the lands cultivated, yielding abundant corn, extensive orchards, and a regularity in the arrangements of their houses which announced prosperity and enjoyment of property; the houses were framed and painted and possessed chimneys (Trans. N. Y. Agr. Soc., 1850, 380), and Gen. Sullivan says of the Indians of the Genessee valley that their fields were fruitful with "every kind of vegetable that could be perceived," and another record catalogues "corn, beans, peas, squashes, potatoes, onions, turnips, cabbages, cucumbers, watermelons, carrots and parsnips (Conover's Early History of Geneva, N. Y., p. 47).

When Verrazzano, 1524, visited the New England coast he found the Indians would trade only at a distance, and when he landed he was welcomed with the war-whoop and clouds of arrows. This is worthy of note as showing that the conditions were unfavorable to agriculture. When Capt. John Smith visited the coast he enumerates "pompions, gourds, strawberries, beans, pease and mayze (The Desc. of New England, 1614, p. 16; Peter

Force Coll. of Tracts, II), and mentions "Mattahunts, two pleasant isles of groves, gardens and corne fields a league in the sea from the mayne" (*ib.*, p. 5), and this indicates a change in the local conditions rather than a change of habits in the people. Champlain, in 1605, describes the method of storing maize in large grass sacks buried under ground in dry places, and mentions the methods of field cultivation at the mouth of the Kennebec and Cape Cod, and finally says that after passing Cape Cod they found much land well tilled in corn and other grains (Champlain's Voy., Prince Soc. ed., p. 121, etc.), and in 1636, when the English made an attack on the Indians of Block island, they found "two hundred acres of land were under cultivation, and the maize, already partly harvested, was piled in heaps to be stored away for winter use (Bryant's Hist. of the U. S., II, 4). When the pilgrims first landed they sent out Miles Standish to explore, and "from thence [Truro] we went on, and found much plain ground, about fifty acres, fit for the plough, and some signs where the Indians formerly planted their corn. * * * * We went on further and found new stubble, of which they had gotten corn this year" (Young's Chron. of the Pilg., 130, 132). This same Nov. 16, 1620, they found "divers fair Indian baskets filled with corn, some whereof was in ears, fair and good, of divers colors" (Morton's New Eng.'s Memorial ed., 1826, p. 40), and Mouart says of this corn, "some yellow, and some red, and others mixt with blue" (Mass. Hist. Soc. Coll., Ser. I, VIII, 210). Higginson (1629) mentions also the color of the corn in New England, as "red, blew and yellow, &c.; and of one corne there springeth four or five hundred" (New England's Plantation, 118, Mass. Hist. Soc. Coll.); and Josselyn, before 1670, describes not only corn of various colors, but beans, pumpkins, squashes, etc. Lescarbot (Hist. Nouv. France, ed. 1612) says the Indians of Maine, like those of Virginia and Florida, plant their corn in hills, along with beans.

At first the Swedish settlements at New Jersey and Pennsylvania (1638) were obliged to buy maize of the Indians for sowing and eating (Peter Kalm, Trav.), and in 1633, on the Delaware river, obtained from the Indians corn and peas (Hazard's Annals of Pa., 32). As showing the importance of corn to the Indians, we may note that Rev. John Campanius, in his Delaware and Swedish translation (1696) of the Catechism, accommodates the

Lord's Prayer to the circumstances of the Indian thus: instead of "give us our daily bread," he has it, "a plentiful supply of venison and corn" (*ib.*, 101). In 1609 Hudson mentions "a great quantity of maize" near where is at present Renssellaer county, N. Y.

In Virginia, Grenville, in 1585, "with hasty cruelty ordered the village to be burned, and the standing corn to be destroyed" (Bancroft, Hist. of the U. S., 1, 96); Heriot, and Strachey mention maize, as also John Smith and many others, and the method of Indian culture is described in "A True Declaration of Virginia," 1610.

In the expedition of Narvaez to Florida, in 1528, maize was found in abundance. In 1544 the Indian tribes everywhere on the route of De Soto's expedition from Florida to Alabama, Mississippi, Missouri and westward were found to be an agricultural people, subsisting largely upon maize, and in De Bry's collection, 1591, Plate XXI, Vol. II, represents Florida Indians of both sexes engaged in the cultivation of the fields. Indeed, there is hardly an account of Florida in the sixteenth century but what mentions inferentially or otherwise maize, beans and pumpkins as being produced in great abundance.

In 1540 Coronado started from Mexico for an expedition northward, and everywhere, where the soil was suitable, found maize and other products of cultivation, even to his most northern point, which is probably the now State of Kansas, a country "well watered by brooks and rivers, * * * the soil was the best strong black mold, and bore plums like those of Spain, nuts, grapes and excellent mulberries. The inhabitants were savages, having no culture but of maize." Marquette in 1673, Alouez in 1676 and Membrè in 1679 all mention the cultivation of maize by the Illinois Indians, and in 1680 Hennepin found corn everywhere in his journey from Niagara to the Mississippi river.

We have now briefly, by the use of a few only of the authorities at our command, shown the existence of the cultivation of maize throughout a large part of the borders of the present United States. A few more references of a later date may serve to impress the fact that the Indians were anciently an agricultural race where the conditions for agriculture were favorable. In Gen. Wayne's letter to the Secretary of War, August, 1794, he speaks of the Delawares of Ohio: "The margin of those beautiful rivers, the Miami's, of the lake and Au Glaize—appear like one

continued village for a number of miles, both above and below this place; nor have I ever before beheld such immense fields of corn in any part of America, from Canada to Florida." Preceding this account, Carver, the celebrated English traveler, who traveled upwards of 5000 miles of the interior about the period of the Revolutionary war, writes that the Ottagammies, the Saukees and all the Eastern nations, were found growing Indian corn. In 1804 the Sioux of the Upper Missouri were found by Lewis and Clark cultivating corn, beans and potatoes, and indeed the references to Indian cultivation either directly by the observers, or indirectly through antiquarian evidence, place beyond a doubt the existence of an agriculture often more or less rude, often more or less perfect, among the tribes of Northern Indians with irrigated fields and a systematized agriculture among some of the tribes of the Southwest.

Let us note very briefly a few points to show that the Northern Indians were intelligently desirous of securing agricultural products which would add to their luxury or support. We will not refer to the Southern or Nahua tribes, for their possession of maize, beans, pumpkins, sweet potatoes, yams, cassava, chocolate, peppers, tomatoes, etc., etc., in numerous varieties are sufficient evidence of their progress in agriculture, even if we refrain from mentioning the gardens of Mexico and Peru, which antedate the existence of similar institutions in France, if Hallam is to be credited, and in Mexico "flowers were the delight of the people."

The melon is mentioned in 1494 as grown by the companions of Columbus at Isabella island, and this is their first occurrence in America. In 1535 Jacques Cartier speaks of the Indians at Hochelega, now Montreal, as having "great store of muskmilions." In 1540 Lopez de Gomara mentions *melons* as grown at Quivira, in the country of Tiguex, which appears to be somewhere in the region of the present Arkansas, and in 1850 Antonio de Espejo found *melons* cultivated by the Concho Indians. In 1542 the army of the viceroy, sent from Mexico to Cibola, found the melon already there. Indeed melons are mentioned by the early visitors in New England, Virginia, Florida and the West. This rapid distribution of a desirable fruit is strong evidence in favor of the care the Indians gave to their fields, in securing and preserving seed.[1]

[1] We must remember, however, that by the older horticulturists the pumpkin was often called a melon.

Peach stones were among the articles ordered by the Governor and Company of the Massachusetts Bay in New England in 1629. In 1683 Wm. Penn speaks of the Indian orchards of peaches about Philadelphia as bearing great abundance of fruit "not inferior to any peach you have in England, except the true Newington." Hilton, in 1664, speaks of peaches abounding in Florida, and Du Pratz, in his history of Louisiana, 1758, says the natives had doubtless got their peach trees from the English colony of Carolina before the French established themselves in Louisiana, and says that they were of the clingstone variety. In the destruction of the Indian settlement at Geneva, N. Y., by Gen. Sullivan in 1779, peaches are enumerated in Major Beatty's account of a near town called Kershong. Among the Indian products destroyed in this invasion, apple, pear and plum trees are also distinctly mentioned, and so remarkable was the town of Kendaia for its orchards, that it was called Apple-town. Wm. Bartram, in his travels in the South about 1773, speaks of the carefully formed orange groves of the Indians, and in one place of a cultivated plantation of shellbark hickory. The settlers of Michigan, in 1805, found here and there about the State orchards of seedling apple trees planted by the Indians, and which, though of great age, were healthy and productive. We thus see that the Indians were willing to exercise a forethought in growing plants which would produce only a long time after being planted.

The cultivation of the potato was first introduced into New England in 1719, and its growing as a field crop is first mentioned at Salem, Mass., in 1762. In 1779, on the authority of Moses Fellows, sergeant of the 3d N. H. regiment, under Gen. Sullivan, the soldiers destroyed, on Sept. 9, at the present Geneva, N. Y., the crops of the Indians, which included "corn, beans, peas, squashes, *potatoes*, onions, turnips, cabbages, cucumbers, watermelons, carrots and parsnips."

Our citations are sufficient to call attention to the agricultural tendencies of the Indian population of North America, and justify in their analyses our first remark, that where the circumstances of climate and soil were favorable, and where the tribal strength was sufficient to protect the crops, the Indians were apparently a people who might properly be termed agricultural.

It is this agricultural feature of the Indian character which tended to develop the many varieties and agricultural species of

maize. At the time of the discovery of the various regions of our country in detail, the Indians had already accomplished in the matter of improvement of varieties of maize what we are at present using, and we have no evidence, I speak after careful research, that any new forms of maize have appeared from our two centuries or more of civilized cultivation. The various agricultural species of maize, the flints, dents, softs, sweets and pops appear to be original forms; the subdivisions of these into local forms appear to have been about as well accomplished by the Indians as by ourselves. The leading forms of maize, in all the cases where sufficient material has been collected for examination, can be referred to an Indian original, and a more cursory examination into all the forms, seems to indicate that this Indian origin is common with all.

If we ask the maize plants themselves to tell their own story, we have for reply:

We are originally of a warm region, for our seeds require about 80° F. for their best germination, and our roots occupy only the hotter regions of the soil. We are of very ancient origin, and many ages ago separated into several groups, for we now represent five different families, which do not easily fraternize and which resist attempts at mingling, to a more or less extent, but not reciprocally. We have been long domesticated, for we have lost the power of becoming feral, in our civilization we do not recognize our barbarian ancestry even by sight, we have long ago separated into agricultural species for the convenience of man, we have within each of our species given to man's continuous asking varieties suited for his necessities to accompany him to regions of short seasons, and to regions unknown to our ancestry. We have varied for man as he has required new wants of us, yet we have maintained the traditions of our origin, when man has not compelled us to discard. We yet ask the temperature for our growth that our ancestors enjoyed; we yet ask that we shall not be subjected to shade. Upon unessentials we have yielded, perhaps after long repeated persuasion, to mold our product to man's desire for quantity, to change our habit of bearing, to get along with a greater or less continuance of heat, to grow larger or smaller plants, to protect ourselves from the thieving of birds or insects, to abandon those agencies for our own survival, from which care man has relieved us. We now

consider ourselves as respectable and useful among man's companions, and in our habits we would show the generations of culture we have received.

Leaving our plant and returning to human experience, we can summarize our view by saying that the problem of similarity of types with great structural diversity of kernel, is only soluble by influences which have had a very long period of time to work in; and the perfectness of the result attained is to be explained only upon the supposition of a very long period of intelligent selective action. It is very probable that a more intimate acquaintance with the facts concerning the development of a single domesticated plant, as gained from philological, physiological and recorded data will some time or other tend to throw some light upon the antiquity of man and the direction and extent of his migrations.

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ON THE EVOLUTION OF THE VERTEBRATA, PROGRESSIVE AND RETROGRESSIVE.[1]

BY E. D. COPE.

(Continued from page 148, February number.)

III. The Line of the Urochorda.

EMBRYOLOGICAL evidence leads us to anticipate that the primitive Vertebrata possessed nothing representative of the vertebrate skeleton beyond a chorda dorsalis. Above this axis should lie the nervous chord, and below it the nutritive and reproductive systems and their appendages. Such a type we have in its simplest form in the Branchiostoma, the representative of the division of the Acrania. In the animals of this division the mouth and anus have the usual vertebrate position, at opposite ends of the body-cavity. The Tunicata (formerly referred to the Mollusca) are now known to present a still more primitive type of Vertebrata, to which the name of Urochorda has been given. These curious, frequently sessile creatures, have a vertebrate structure during the larval stage, which they ultimately lose. They have the necessary chorda, and nervous axis with a brain, and a cerebral eye. They have at this time a tail, and are free-swimming; a peculiarity which a few of them retain throughout life (Appen-

[1] A lecture delivered before the Franklin Institute, Jan. 16, 1884. (Erratum: on p. 147, 2d line from bottom, omit "Batrachia.")

dicularia).[1] They differ from the Acrania in the positions of the extremities of the alimentary canal. The mouth is on the top of the anterior end of the animal, and is supposed by some anatomists to represent an open extremity of the pineal gland of other Vertebrata; while the tract represented by this body, the third ventricle of the brain, and the pituitary body of the Craniata, are the remains of the primitive œsophagus of the Urochorda. The anus in the adult tunicates is either dorsal, or it opens into the body cavity, as in the young larvæ. In Appendicularia it is ventral (Gegenbaur).

The history of the Tunicata cannot be traced by palæontologists as yet, owing to the absence of hard parts in their structure. The evidence of embryology has, however, convinced phylogenists that the ancestors of this class resembled their larvæ, and that they have as a whole undergone a remarkable degeneracy. They have passed from an active, free life to a sessile one, and have lost the characters which pertain to the life of vertebrates generally.

It was to have been anticipated, however, that all of these ancestral Tunicata did not undergo this degenerative metamorphosis, for it is to such types that we must look for the ancestors of the other Vertebrata, the Acrania and the Craniata. And here palæontology steps in and throws new light on the question. I have pointed out briefly, on another page of the NATURALIST,[2] that a second order must be added to the Urochorda, viz., the Antiarcha, in which the anus presents the same position as in the Acrania, at the posterior end of the body, while an orifice of the upper surface represents the mouth of the Tunicata. To this order is to be referred the family of the Pterichthyidæ, of which the typical genus, Pterichthys, is a well-known form of the Devonian period. This genus retained its tail, which was the cause, in connection with the presence of lateral fin-like appendages, of its having been supposed to be a fish, by Agassiz, Hugh Miller and others. It is possible that the American *Bothriolepis canadensis* lost its tail, as in the majority of Urochorda. The tunicate which approaches nearest to the Antiarcha is the arctic Chelyosoma.

From the Antiarcha to the Acrania and Craniata, then, the line is an ascending one.

[1] See Lankester on Degeneration, Nature Series, 1880.

[2] This (March) number, 1885, under "Geology and Palæontology."

IV. The Line of the Pisces.

The fishes form various series and subseries, and the tracing of all of them is not yet practicable owing to the deficiency in our knowledge of the earliest or ancestral forms. Thus the origins of the four subclasses, Holocephali, Dipnoi, Elasmobranchii and Hyopomata, are lost in the obscurity of the early Palæozoic ages.

A comparison of the four subclasses just named shows that they are related in pairs. The Holocephali and Dipnoi have no distinct suspensory segment for the lower jaw, while the Elasmobranchii and Hyopomata have such a separate element. The latter therefore present one step in the direction of complication beyond the former, but whether the one type is descended from the other, or whether both came from a common ancestor or not, is unknown. If one type be derived from the other it is not certain which is ancestor, and whether the process has been one of advance or retrogression. The fauna of the Permian epoch throws some light on the relations of these subclasses in other respects. The order of the Ichthyotomi,[1] while belonging technically to the Elasmobranchi, presents characters of both the Dipnoi and the Hyopomata. It is so near to the Dipnoi in the characters of the skull that nothing save the presence of a free suspensor of the lower jaw prevents its entering that subclass. It indicates that the one of these divisions is descended from the other, or both from a common division which may well be the group Ichthyotomi itself. In case the Elasmobranchi have descended from the Ichthyotomi, they have undergone degeneracy, as the Ichthyotomi have a higher degree of ossification and differentiation of the bones of the skull. If they descended from a purely cartilaginous type of Dipnoi, they have advanced, in the addition of the free hyomandibular. If the Dipnoi have descended from either division, they have retrograded, in the loss of the free hyomandibular. As regards the Hyopomata, we have a clear advance over the other subclasses in the presence of the maxillary arch and the opercular apparatus.

Too little is known of the history of the subclasses, excepting the Hyopomata, for us to be able to say much of the direction of the descent of their contained orders. On the sharks some light is shed by the discovery of the genus Chlamydoselachus Gar-

[1] See Palæontological Bulletin No. 38, E. D. Cope, 1884, p. 572, on the genus Didymodus.

man,[1] which is apparently nearly related to the Cladodonts of the Devonian seas. This genus has more numerous branchial slits than all but two of the genera of existing sharks, and it differs from all but these two in having a more perfect articulation between the tooth-bearing bones and the cranium. Of the Hyopomata a much clearer history is accessible. It has three primary divisions or tribes which differ solely in the structure of the supports of the fins. In the first division, the Crossopterygia, the anterior limbs have numerous actinosts which are supported on a peduncle of axial bones. The posterior limbs are similar. In the second division, or Chondrostei (the sturgeons, etc.), the posterior limb remains the same, while the anterior limbs have undergone a great abbreviation in the loss of the axial bones and the reduction of the number and length of the actinosts. In the third group, or Actinopteri,[2] both limbs have undergone reduction, the actinosts in the posterior fin being almost all atrophied, while those of the fore limb are much reduced in number.

The phylogeny of these tribes is not easy to make out at present. The descent has been no doubt in the order named in time, but the starting point is yet uncertain. Thus the Chondrostei appear later in time than either of the other tribes, a history which probably only represents our ignorance. The characters of the genus Crossopholis Cope, from the American Eocene, strongly suggests that the existing forms have descended from scaled ancestors. The Crossopterygian fore limb, with its arm-like axis, tells of the origin of the first limbed vertebrates, the Batrachia, whose skull-structure, however, only permits their derivation from the Dipnoi or Holocephali. As the former subclass has the Crossopterygian fin structure, we can safely regard them as the ancestors of the Batrachia, while the Crossopterygia are a side line from a similar type, probably the Ichthyotomi, because these have a free suspensor of the lower jaw. But of the structure of the fins of the Ichthyotomi unfortunately we know nothing. If this position be true, then the successive derivation of the Chondrostei and the Hyopomata in one line is rendered probable. The modification of structure has consisted in the contraction of the supporting elements of the pectoral and ventral fins by the reduction of their numbers and length. According to palæontological

[1] Proceedings American Assoc. Adv. Sci., 1884.

[2] Partly agrees with the Teleostei of Müller, but includes many of his Ganoidea.

history, however, the tribe with most contracted fins, Actinopteri, appeared in the Coal measures (Paleoniscidæ), or very soon after the Crossopterygia in the Devonian.

The descent of the fishes in general has witnessed, then, a contraction of the limbs to a very small compass and their substitution by a system of accessory radii. This has been an ever widening divergence from the type of the higher Vertebrata, and from this standpoint, and also a view of the "loss of parts without complementary addition of other parts," may be regarded as a process of degradation.

Taking up the great division of the Actinopteri, which embraces most of the species of living fishes, we can trace the direction of descent largely by reference to their systematic relations when we have no fossils to guide us.

The three subtribes adopted by Jordan represent three series of the true fishes which indicate lines of descent. The Holostei include the remainder of the old ganoids after the subtraction of the Crossopterygia and the Chondrostei. They resemble these forms in the muscular bulbus arteriosus of the heart and in the chiasm of the optic nerves. Both of these characters are complexities which the two other divisions do not possess, and which, as descendants coming later in time, must be regarded as inferior, and therefore to that extent degenerate. Of these divisions the Physostomi approach nearest the Holostei, and are indeed not distinctly definable without exceptions. The third division, or Physoclysti, shows a marked advance beyond the others in: (1) The obliteration of the primitive trachea, or ductus pneumaticus, which connects the swim-bladder and œsophagus; (2) the advance of the ventral fins from the abdomen forwards to the throat; (3) the separation of the parietal bones by the supraoccipital; (4) the presence of numerous spinous rays in the fins; and (5) the roughening of the edges of the scales, forming the ctenoid type. There are more or less numerous exceptions to all of these characters. The changes are all further divergences from the other vertebrate classes, or away from the general line of ascent of the vertebrate series taken as a whole. The end gained is specialization, but whether the series can be called either distinctively progressive or retrogressive is not so clear. The development of osseous spines, rough scales and other weapons of defense, together with the generally superior energy and tone which prevail

among the Physoclysti, characterize them as superior to the Physostomi, but their departure from the ascending line of the Vertebrata has another appearance.

The descent of the Physoclystous fishes has probably been from Holostean ancestors, both with and without the intervention of Physostomous forms. This is indicated by increase in the number of actinosts in the fins of families which have pectoral ventral fins, as in the extinct genus Dorypterus.[1]

The Physostomi display three or four distinct lines of descent. The simplest type is represented by the order Isospondyli, and palæontology indicates clearly that this order is also the oldest, as it dates from the Trias at least. In one line the anterior dorsal vertebræ have become complicated, and from an interlocking mass which is intimately connected with the sense of hearing. This series commences with the Characinidæ, passes through the Cyprinidæ, and ends with the Siluridæ. The arrangements for audition constitute a superadded complication, and to these are added in the Siluroids defensive spines and armor. Some of this order, however, are distinctly degenerate, as the soft purblind Ageniosus, and the parasitic Stegophilus and Vandellia which are nearly blind, without weapons, and with greatly reduced fins.

The next line (the Haplomi, pike, etc.) loses the præcoracoid arch and has the parietal bones separated, both characters of the Physoclysti. This group was apparently abundant during the Cretaceous period, and it may have given origin to many of the Physoclysti.

Another line also loses the præcoracoid, but in other respects diverges totally from the Physoclysti and all other Physostomi. This is the line of the eels. They next lose the connection between the scapular arch and the skull, which is followed by the loss of the pectoral fin. The ventral fin went sooner. The palatine bones and teeth disappear, and the suspensor of the lower jaw grows longer and loses its symplectic element. The opercular bones grow smaller, and some of them disappear. The ossification of most of the hyoid elements disappears, and some of their cartilaginous bases even vanish. These forms are the marine eels or Colocephali. The most extraordinary example of specialization and degeneracy is seen in the abyssal eels of the family Eurypharyngidæ. Here all the degenerate features above

[1] See Proceeds Amer. Assoc Adv. Science, 1878, p. 297.

mentioned are present in excess, and others are added, as the loss of ossification of a part of the skull, almost total obliteration of the hyoid and scapular arches, and the semi-notochordal condition of the vertebral column, etc.

The Physoclysti nearest the Physostomi have abdominal ventral fins, and belong to several orders. It is such types as these that may be supposed to have been derived directly from Holostean ancestors. They appear in the Cretaceous period (Dercetidæ), along with the types that connect with the Physostomi (Haplomi). Intermediate forms between these and typical Physoclysti occur in the Eocene (Trichophanes, Erismatopterus), showing several lines of descent. The Dercetidæ belong apparently to the order Hemibranchi, while the Eocene genera named belong apparently to the Aphododiridæ, the immediate ancestor of the highest Physoclysti, the Percomorphi. The order Hemibranchi is a series of much interest. Its members lose the membrane of their dorsal spinous fin (Gasterosteidæ), and then the fin itself (Fistularia, Pegasus). The branchial apparatus has undergone, as in the eels, successive deössification (by retardation), and this in direct relation to the degree with which the body comes to be protected by bony shields, reaching the greatest defect in the Amphisilidæ. One more downward step is seen in the next succeeding order of the Lophobranchii. The branchial hyoid apparatus is reduced to a few cartilaginous pieces and the branchial fringes are much reduced in size. In the Hippocampidæ the caudal fin disappears and the tail becomes a prehensile organ by the aid of which the species lead a sedentary life. The mouth is much contracted and becomes the anterior orifice of a suctorial tube. This is a second line of unmistakable degeneracy among true fishes.

The Physoclysti with pectoral ventral fins present us with perhaps ten important ordinal or subordinal divisions. Until the palæontology of this series is better known, we shall have difficulty in constructing phylogenies. Some of the lines may, however, be made out. The accompanying diagram will assist in understanding them.

The Anacanthini present a general weakening of the organization in the less firmness of the osseous tissue and the frequent reduction in the size and character of the fins. The caudal vertebræ are of the protocercal type. As this group does not appear

early in geological time, and as it is largely represented now in the abyssal ocean fauna, there is every reason to regard it as a degenerate type. The Scyphobranch line presents a specializa-

tion of the superior pharyngeal bones, which is continued by the Haplodoci (Batrachidæ). This cannot be called a degenerate line, although the fin-rays are soft. The Heterosomata (flounders)

found it convenient to lie on one side, a habit which would appear to result from a want of motive energy. The fins are very inefficient organs of movement in them, and they are certainly no rivals for swift-swimming fishes in the struggle for existence, excepting as they conceal themselves. In order to see the better while unseen, the inferior eye has turned inwards, *i. e.*, upwards, and finally has penetrated to the superior surface, so that both eyes are on one side. This peculiarity would be incredible if we did not know of its existence, and is an illustration of the extraordinary powers of accommodation possessed by nature. The Heterosomata can only be considered a degenerate group.

The double bony floor of the skull of the Distegous percomorph fishes is a complication which places them at the summit of the line of true fishes. At the summit of this division must be placed the Pharyngognathi, which fill an important role in the economy of the tropical seas, and the fresh waters of the Southern hemisphere. By means of their powerful grinding pharyngeal apparatus they can reduce vegetable and animal food inaccessible to other fishes. The result is seen in their multifarious species and innumerable individuals decked in gorgeous colors, and often reaching considerable size. This is the royal order of fishes, and there is no reason why they should not continue to increase in importance in the present fauna.

Very different is the line of the Plectognathi. The probable ancestors of this division, the Epilasmia (Chætodontidæ, etc.), are also abundant in the tropical seas, and are among the most brilliantly colored of fishes. One of their peculiarities is seen in a shortening of the brain-case and prolongation of the jaws downwards and forwards. The utility of this arrangement is probably to enable them to procure their food from the holes and cavities of the coral reefs among which they dwell. In some of the genera the muzzle has become tubular (Chelmo), and is actually used as a blow-gun by which insects are secured by shooting them with drops of water. This shortening of the basicranial axis has produced a corresponding abbreviation of the hyoid apparatus. The superior pharyngeal bones are so crowded as to have become a series of vertical plates like the leaves of a book. These characters are further developed in the Plectognathi. The brain-case is very small, the face is very elongate, and the mouth is much contracted. The bones surrounding it in each jaw are coössified.

The axial elements (femora) of the posterior fins unite together, become very elongate and lose the natatory portion. In one group (Orthagoriscidæ) the posterior part of the vertebral column is lost and the caudal fin is a nearly useless rudiment. In the Ostraciontidæ (which may have had a different origin as the pharyngeal bones are not contracted), the natatory powers are much reduced, and the body is enclosed in an osseous carapace so as to be capable of very little movement. The entire order is deficient in osseous tissue, the bones being thin and weak. It is a marked case of degeneracy.

There are several evident instances of sporadic degeneracy in other orders. One of these is the case of the family of the Icosteidæ, fishes from deep waters off the coast of California. Although members of the Percomorphi, the skeleton in the two genera Icosteus and Icichthys is unossified, and is perfectly flexible. Approximations to this state of things are seen in the parasitic genus Cyclopterus, and in the ribbon fishes, Trachypteridæ.

Thus nearly all the main lines of the Physoclysti are degenerate; the exceptions are those that terminate in the Scombridæ (mackerel), Serranidæ, and Scaridæ (Pharyngognathi).

V. The Line of the Batrachia.

We know Batrachia first in the coal measures. They reach a great development in the Permian epoch, and are represented by large species in the Triassic period. From that time they diminish in numbers, and at the present day form an insignificant part of the vertebrate fauna of the earth. The history of their succession is told by a table of classification, such as I give below:

I. Supraoccipital, intercalary and supratemporal bones present. Propodial bones distinct.

Vertebral centra, including atlas, segmented, one set of segments together supporting one arch..... *Rachitomi.*

Vertebræ segmented, the superior and inferior segments each complete, forming two centra to each arch..... *Embolomeri.*

Vertebral centra, including atlas, not segmented, one to each arch..... *Stegocephali.*

II. Supraoccipital and supratemporal bones wanting. Frontal and propodial bones distinct.

a. An os intercalare.

A palatine arch and separate caudal vertebræ..... *Proteida.*

aa. No os intercalare.

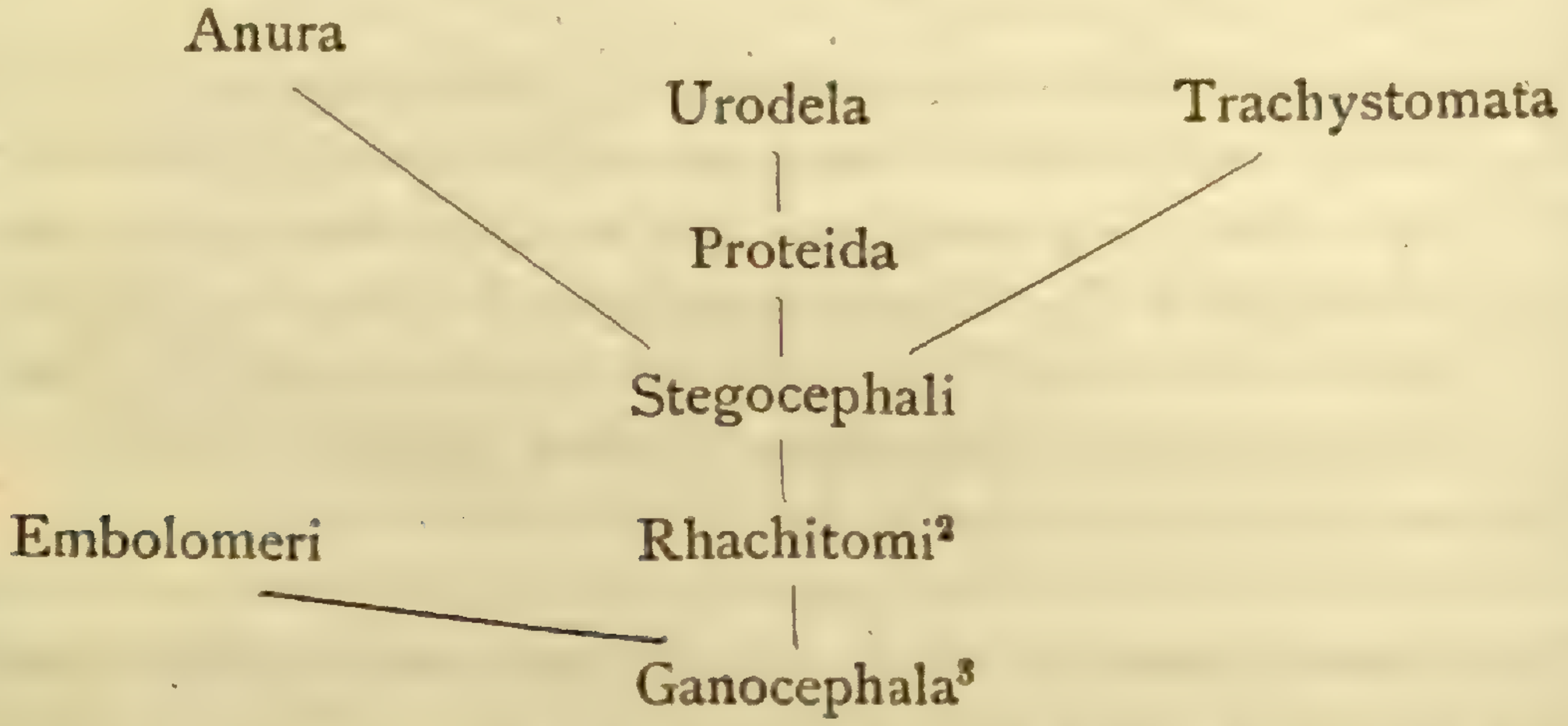
A maxillary arch; palatine arch imperfect; nasals, premaxillaries and caudal vertebræ distinct..... *Urodela.*[1]

No maxillary or palatine arches; nasals and premaxillary, also caudal vertebræ, distinct..... *Trachystomata.*

III. Supraoccipital, intercalare and supratemporal bones wanting. Frontals and parietals connate; propodial bones and caudal vertebræ confluent.

Premaxillaries distinct from nasals; no palatine arch; astragalus and calcaneum elongate, forming a distinct segment of the limb..... *Anura.*

The probable phylogeny of these orders as imperfectly indicated by palæontology is as follows:



An examination of the above tables shows that there has been in the history of the Batrachian class a reduction in the number of the elements composing the skull, both by loss and by fusion with each other. It also shows that the vertebræ have passed from a notochordal state with segmented centra, to biconcave centra, and finally to ball and socket centra, with a great reduction of the caudal series. It is also the fact that the earlier forms (those of the Permian epoch) show the most mammalian characters of the tarsus and of the pelvis.[4] The later forms, the salamanders, show a more generalized form of carpus and tarsus and of pelvis also. In the latest forms, the Anura, the carpus and tarsus are reduced through loss of parts, except that the astragalus and calcaneum are phenomenally elongate. We have then, in the Batrachian series, a somewhat mixed kind of change; but it principally consists of concentration and consolidation of parts. The question as to whether this process is one of progression or

[1] Probably includes the Gymnophiona.

[2] Includes the Eryopidæ.

[3] Includes Trimerorhachidæ and Archegosauridæ.

[4] The tarsus of Eryops is much like that of the Theromorph reptiles. See Proceeds. Amer. Philos. Soc., 1884, p. 38.

retrogression may be answered as follows: If degeneracy consists in "the loss of parts without complementary addition of other parts," then the Batrachian line is a degenerate line. This is only partly true of the vertebral column, which presents the most primitive characters in the early, Permian, genera (Rhachitomi). If departure from the nearest approximation to the Mammalia is degeneracy, then the changes in this class come under that head. The carpus, tarsus and scapular and pelvic arches of the Rachitomi are more mammalian than are those of any of their successors.

There are several groups which show especial marks of degeneracy. Such are the reduced maxillary bones and persistent gills of the Proteïda; the absence of the maxillary bones and the presence of gills in the Trachystomata; the loss of a pair of legs and feebleness of the remaining pair in the sirens; and the extreme reduction of the limbs in Amphiuma. Such I must also regard, with Lankester, the persistent branchiæ of the Siredons. I may add that in the brain of the Proteïd Necturus the hemispheres are relatively larger than in the Anura, which are at the end of the line.

It must be concluded, then, that in many respects, the Batrachia have undergone degeneracy with the passage of time.

VI. The Reptilian Line.

As in the case of the Batrachia, the easiest way of obtaining a general view of the history of this class is by throwing their principal structural characters into a tabular form. As in the case of that class I commence with the oldest forms and end with the latest in the order of time, which, as usual, corresponds with the order of structure. I except from this the first order, the Ichthyopterygia, which we do not know prior to the Triassic period:[1]

A. Extremities not differentiated in form beyond proximal segment.

I. Os quadratum immovably articulated to squamosal, etc.

Tubercular and capitular rib articulations present and distinct . . . 1. *Ichthyopterygia.*

AA. Elements of extremities differentiated.

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[1] Generally similar to the system published by me. Proceedings Amer. Ass. Adv. Science, XIX, p. 233.

II. Os quadratum immovably articulated; capitular and tubercular rib-articulations distinct. Archosauria.

Pubis and ischium united, and with little or no obturator foramen; one posterior cranial arch; limbs ambulatory; a procoracoid .....2. *Theromorpha*

Ischium and pubis distinct, the latter directed forwards, backwards or downwards; two posterior cranial arches; limbs ambulatory; no procoracoid . 3. *Dinosauria.*[1]

Ischium and pubis united; two postcranial arches; anterior limbs volant 4. *Ornithosauria.*

III. Os quadratum closely united to cranial arches; but one rib-articulation. Synaptosauria.

Distinct hyposternal and postabdominal bones; ribs joining each two vertebræ, and generally forming a carapace; one posterior cranial arch.....5. *Testudinata.*

Hyposternal and postabdominal bones not distinct; two posterior cranial arches; ribs attached to one vertebra; a sternum; ? no procoracoid 6. *Rhynchocephalia.*

Hyposternal and postabdominal bones not distinct; two posterior cranial arches; ribs attached to one centrum; no sternum[2]; a procoracoid ...7. *Sauropterygia.*

IV. Os quadratum attached only at the proximal extremity, and more or less movable; ribs with one head. Streptostylica.[3]

Brain case membranous in front of proötic bone; trabecula not persistent 8. *Lacertilia.*

Brain case with osseous walls anterior to proötic; a scapular arch and sternum 9. *Pythonomorpha.*[4]

Brain case with osseous walls anterior to proötic; no scapular arch nor sternum; trabecular grooves of sphenoid and presphenoid bones.....10. *Ophidia.*

An inspection of the characters of these ten orders, and their consideration in connection with their geological history will give a definite idea as to the character of their evolution. The history of the class, and therefore the discussion of the question, is limited in time to the period which has elapsed since the Permian epoch inclusive, for it is then that the Reptilia enter the field of our knowledge. During this period but one order of reptiles inhabited the earth, so far as now known, that of the Theromorpha. The important character and role of this type may be inferred from the fact that they are structurally nearer to both the Batrachia and the Mammalia than any other, but present characters which render it probable that all the other reptiles, with possibly the exception of the

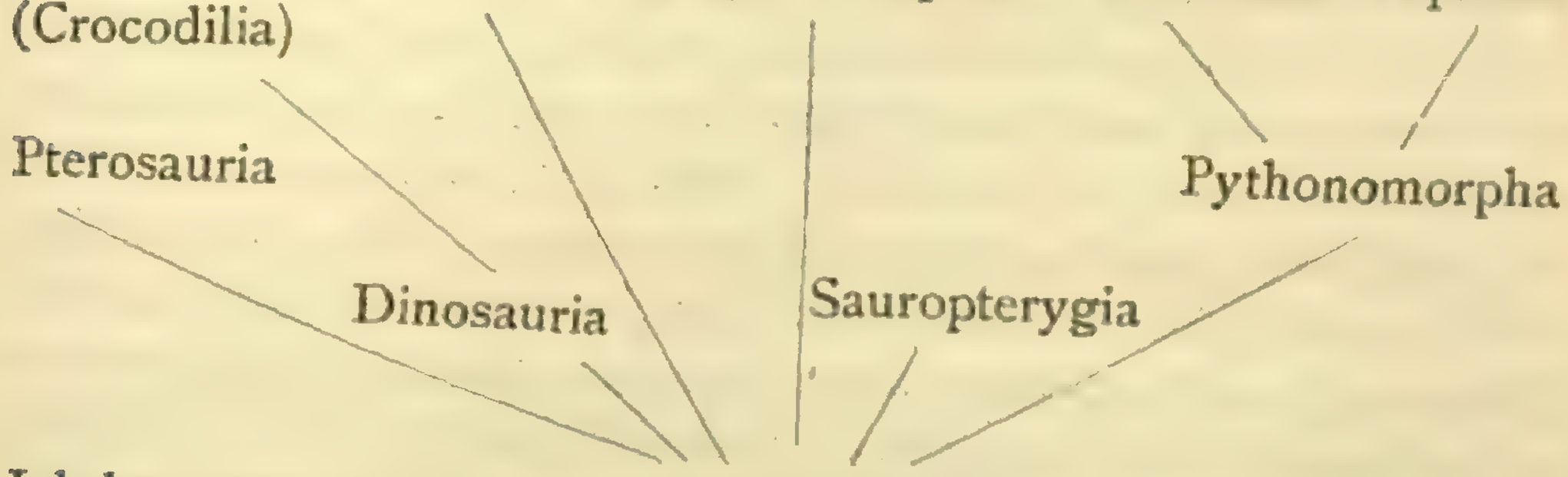
[1] This definition includes the Crocodilia in the Dinosauria, as it is absolutely connected with the typical Dinosaurs by the Opisthocœla (Sauropoda Marsh).

[2] Episternum present.

[3] It is quite possible that the three divisions of this head form one natural order, the Streptostylica, or Squamata.

[4] Including Choristodera, see AMERICAN NATURALIST, 1884, p. 815.

Ichthyopterygia, derived their being from them. The phylogeny may be thus expressed:



(To be continued.)

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ON THE LARVAL FORMS OF SPIRORBIS BOREALIS DAUDIN.

BY J. WALTER FEWKES.

NATURALISTS who are engaged in the identification of the larval forms which marine animals pass through in their growth from the egg, find great difficulty in this study from the lack of direct observations in raising these larvæ from the eggs or in rearing them directly into the adult. This is particularly true in regard to the young of marine annelids, a most profitable field for new observations and one which has had but few cultivators among American naturalists. The following paper is offered as a help to those engaged in this study and not as an extended account of the embryology of the animal of which it treats. It is especially intended for those who are interested in the identification of our marine annelid larvæ.[1]

A genus of chætopod annelids called Spirorbis, as is well known, in its adult and older larval stages, secretes a coiled calcareous case, commonly called its shell, in which it lives. This case is permanently cemented or attached to some foreign body, from which fact the adult is incapable of locomotion. Not so, however, the larva, which is destitute of any such shell, is not fixed but is free swimming, and often captured with the dip-net in surface fishing. From the great dissimilarity in outward form as

[1] The observations here recorded were made in the Zoölogical Laboratory at Newport, R. I. I am indebted to Mr. A. Agassiz for facilities to carry on my studies at that place.

well as the different habitat of the young and adults, the free-swimming larva is often unrecognized or not connected with the genus of which it is the young.

I have often, in former years, captured the larval Spirorbis by surface fishing, but up to a short time ago have been unable to discover to what adult it belongs. Last summer I was fortunate enough to raise these larvæ from the eggs, and am now able to state definitely most of the changes in external form which Spirorbis goes through between the last stages of the segmentation of the egg and the time when it fastens itself to some foreign object and begins its sessile and adult life.

The eggs of *Spirorbis borealis* are easily obtained in considerable numbers. If live adults, enclosed in their cases, be placed in a proper receptacle in water, and the calcareous shells crushed, among the fragments there will be found chains composed of bead-like strings of ova strung along together. These chains are easily distinguished from the other soft parts of the Spirorbis body by their brown or red color. I found a good way to obtain the eggs was to place a number of Spirorbes in a watch crystal with water and then crush the cases with a spatula. Remove the fragments of shells and the strings of eggs are easily seen at the bottom of the watch crystal.

As the adult Spirorbis is very hardy the young can easily be raised from the adult by keeping the latter in an aquarium for a few days, when multitudes of the young make their way out of the worm cases and can be easily found swimming at or near the surface of the water in which they are kept. The young from which the present studies were made were taken in the months of July and August, 1884.

The eggs of *Spirorbis borealis* have a reddish-brown color and are arranged side by side in short strings composed of from one to four rows of from ten to fifteen or more eggs each. The later stages in the segmentation of the egg resemble those of other chætopod eggs and can easily be studied in strings taken from the Spirorbis cases. The younger stages of the segmentation were not found. Each egg is enclosed in a membranous sac, while all the ova lie in a common digitiform structure binding them together. The earliest stages in the development of the larva are passed through while the eggs are thus enclosed.

It will be observed that the larvæ of Spirorbis now to be de-

scribed differ in some particulars from those of "*S. spirillum* Gould (non Pagenst.; an Lam.?)," described by A. Agassiz (*Ann. Lyc. Nat. Hist.*, VIII, pp. 318–323). They differ even more widely from the young of *S. spirillum* described by Pagenstecher (*Zeit. f. Wiss. Zool.*, XII). I regard my larvæ of the same species as that described as *S. spirillum* by Augustus A. Gould (Report on the Invertebrata of Massachusetts [first edition], Boston, 1841).

A. Agassiz says of *S. spirillum* (*op cit.*, p. 318): "The eggs, of a dark reddish-brown color, are found in strings formed of two rows (fig. 18), either on each side of the alimentary canal in the anterior part of the body, where in the adult we find a considerable space free of bristles (as in fig. 25), or else when the strings have been laid they are found on the sides of the body, between it and the limestone tube, and here the young undergo their transformations." Later he says: "The young are quite advanced within the body of the parent previous to the transfer of the egg-sacs to the cavity of the tube where they complete the greater part of their growth." In his figure 18 the larvæ in the strings have already well formed eye spots. I have never been able to observe these larvæ in stages of development in the body of the parent, but have found many specimens of eggs outside the walls of the body of the adult, which were in the last stages of segmentation and therefore much younger than those figured by him (fig. 18).

In the first or youngest stage after segmentation a larval condition was observed in which the embryo almost wholly fills the egg capsule and presents very little differentiation in different regions. This embryo is of an oblong shape and is girt equatorially by a ring of cilia. On one side just below this ciliated belt the wall of the embryo is flattened. The body is opaque, has a dark brown or reddish color, and is destitute of eye spots.

In the next oldest stage (Fig. 1), which is very similar to the young of the genus Pileolaria, figured by Salensky (Etude sur le Developpement des Annelides, Pl. IV, Fig. 7), we have a central, opaque yolk-mass surrounded by a more transparent layer of cells which is thickest on the same side as the flattening noticed in the walls of the larva in a previous stage, a pair of eye spots and a crescentic-shaped body, which is probably lens-shaped when seen in another view, lying between the outer layer of the embryo and its inner cell contents. The external layer I have followed Salensky in regarding as the epiblast and the thin intermediate layer the

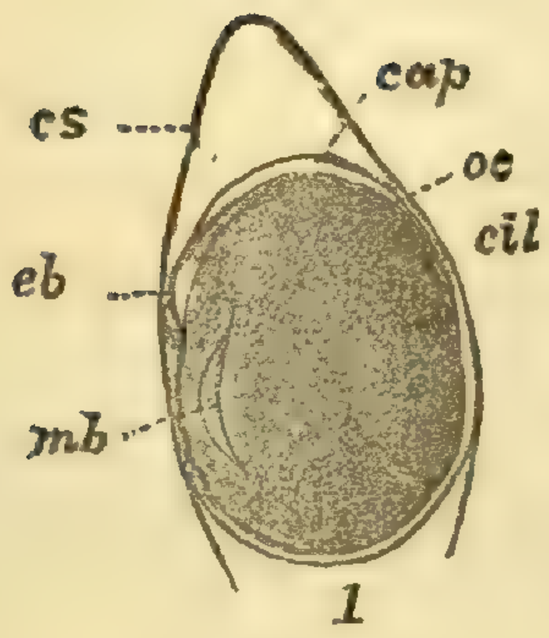
mesoblast. The ring of cilia is seen in profile on each side above the equator of the embryo.

One of the best eggs to use in following the changes has been found to be the last of the chain, since it is always isolated, on one side at least, from the rest. We often find strings of ova with the eggs in a single row. These eggs have always been found well suited for study on account of this simple arrangement. The members of a chain can also be separated from each other without injury.

In the next oldest larva to that just mentioned (Figs. 2, 3, 4), we find the indentation on the flattened side of the embryo still more pronounced than before, as shown in Fig. 2, which represents the larva as seen from one side. If this larva is seen from the posterior pole (Fig. 3), we notice two prominent protuberances which impart to it as seen in this way an irregular triangular shape. From the ventral side (Fig. 4), upon which the protuberances lie, these appendages appear as small lateral projections (*pj*) on each side. The embryo fills almost the whole interior of the capsule in which it is now confined, and the protuberances lie just below the ring of vibratile cilia. From this stage it seems that the collar which is later found on the ventral side of the larva originates as two projections, one on each side. In a larva somewhat older than the last (Figs. 5, 6, 7), the collar (*col*) has formed by the union of the two projections, and has grown somewhat downward over the ventral side of the posterior region of the body. Fig. 7 shows the same embryo as seen from the anterior pole, and Fig. 6 the same from the ventral side. The dorsal surface of the larva is more curved than in younger embryos.

In Fig. 9 the larva is still enclosed in its capsule, and is represented from the ventral region, while the collar is still more developed, and two pairs of single spines were observed in the region partially covered by the collar.[1]

[1] Pagenstecher describes and figures (*op. cit.*, Pl. XXXIX, Fig. 6) a first pair of spines consisting of three on each side at the base of the collar which I have not found in my larvæ. He says, "An der Wurzel des Kragens sprosst das erste Paar von Borstenbündeln hervor, vorläufig mit je drei Borsten." I do not find these represented in the young of *Spirorbis borealis*, and A. Agassiz neither mentions nor figures them in his Spirorbis. My observations do not agree with those of Pagenstecher when he says, "Die erste Spur der Tentacle zeigt sich in Form von drei Höckern jederseits auf dem Kopflappen." I have also been unable to find in my species the oval, green spots, "ovalen gelben Fleck," which he describes "neben dem Magen rechts und links."



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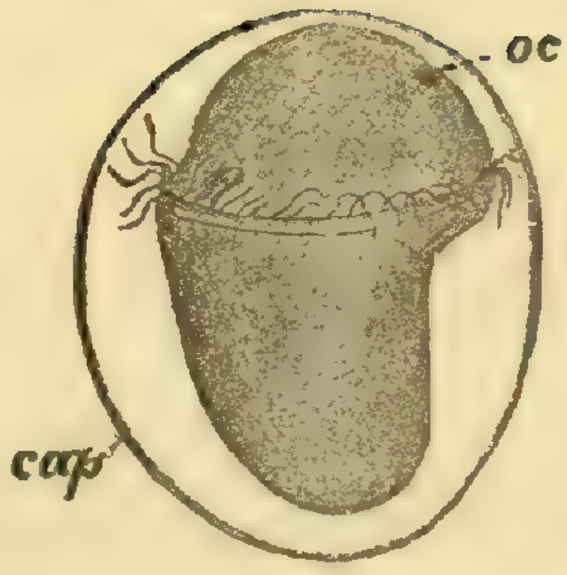

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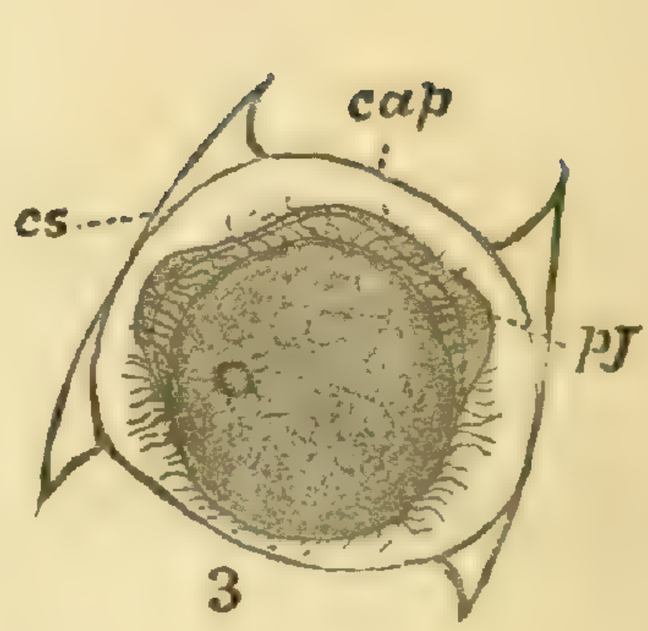

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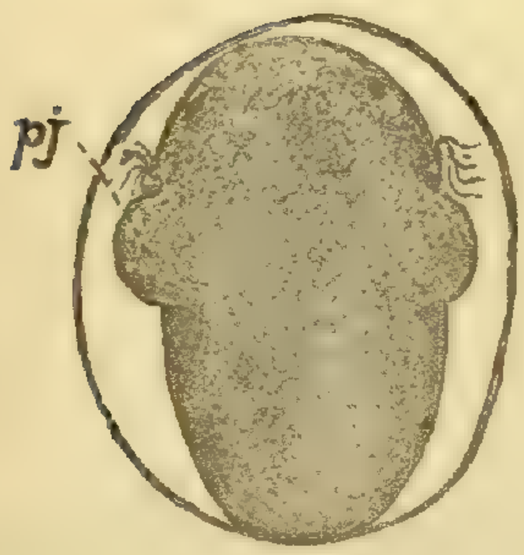

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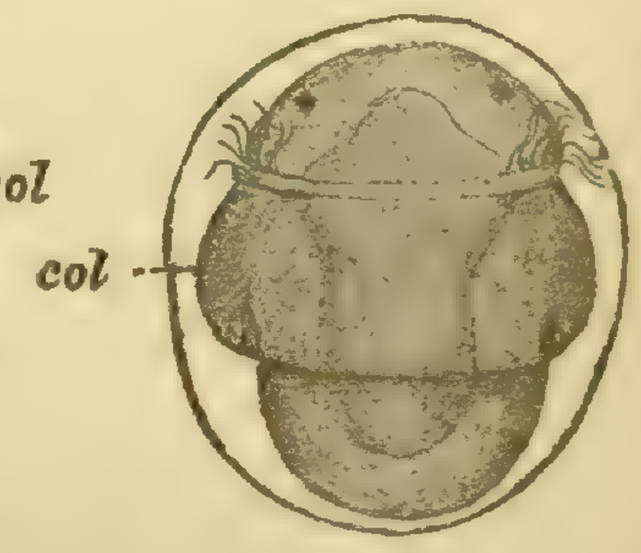

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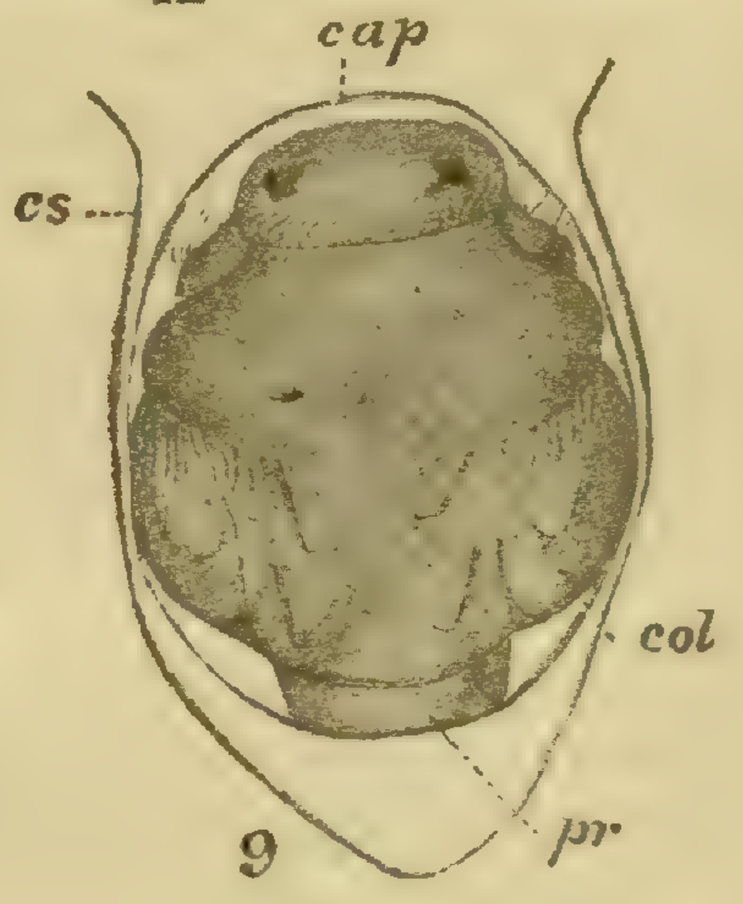


9

Larval forms of *Spirorbis borealis*.

Fig. 9 is the youngest stage of development of Spirorbis in which lateral spines were observed, and in it there are two pairs, a single spine on each side in each pair. This character is also recorded in one of the larval stages observed by A. Agassiz, he says: "The bristles make their appearance in figure 21, where we find two of the three bundles of the collar-like projection of the anterior extremity always distinctly marked in such young embryos." In figs. 4 and 5, Pl. XXXIX, in Pagenstecher's account, it appears in the youngest stage that the spines are represented by a single pair.

The larva in my plate (XI, Fig. 8) is represented as divided into three marked regions, which from now on will be known as the anterior or cephalic, the middle covered on its ventral side by a much larger growth of the collar and a smaller posterior region. The first and second of these divisions are separated by a ring of cilia, the second and posterior by the posterior border of the collar. The prominent lateral ocellus lies on the ventral side of the larva and has a bright red color. The whole body of the embryo is reddish, while the external surface of the collar as well as the ventral region of the posterior part of the embryo is covered with small cilia. On the walls of the ventral region just below the collar there arises a brick-red projection. I have homologized this projection with the "glandes tubipares" described by Salensky in the young of the genus Pileolaria. In this latter genus, however, these glands are arrayed laterally instead of medially and ventrally. In Spirorbis as in Pileolaria I find three ciliated regions which we may follow Salensky in designating: 1. Couronne ciliaire. 2. Couronne ciliaire abdominale. 3. Couronne ciliaire anale.

The interior of the larva on the dorsal side is occupied by a brownish body which is in part the unabsorbed yolk mass.

Through all the stages of growth thus far traced the embryo is still included in its egg capsule. It was observed to fret continually against its envelope and with its spines it constantly presses upon the walls of the same. The motion of these spines shows at once that the egg capsule has flexible walls yielding easily to such pressure. In the next stage (Fig. 10) the larva has become free from the capsule, swimming about in the water with considerable activity. Judging from A. Agassiz's statement in regard to the amount of the development of the side branches of the tentacles,

the young of the Spirorbis which he studied leaves the egg capsule with its cephalic appendages much more developed than I have observed them to be in *S. borealis*. No branching appendages were seen in the youngest larvæ found free in the water in my specimens.

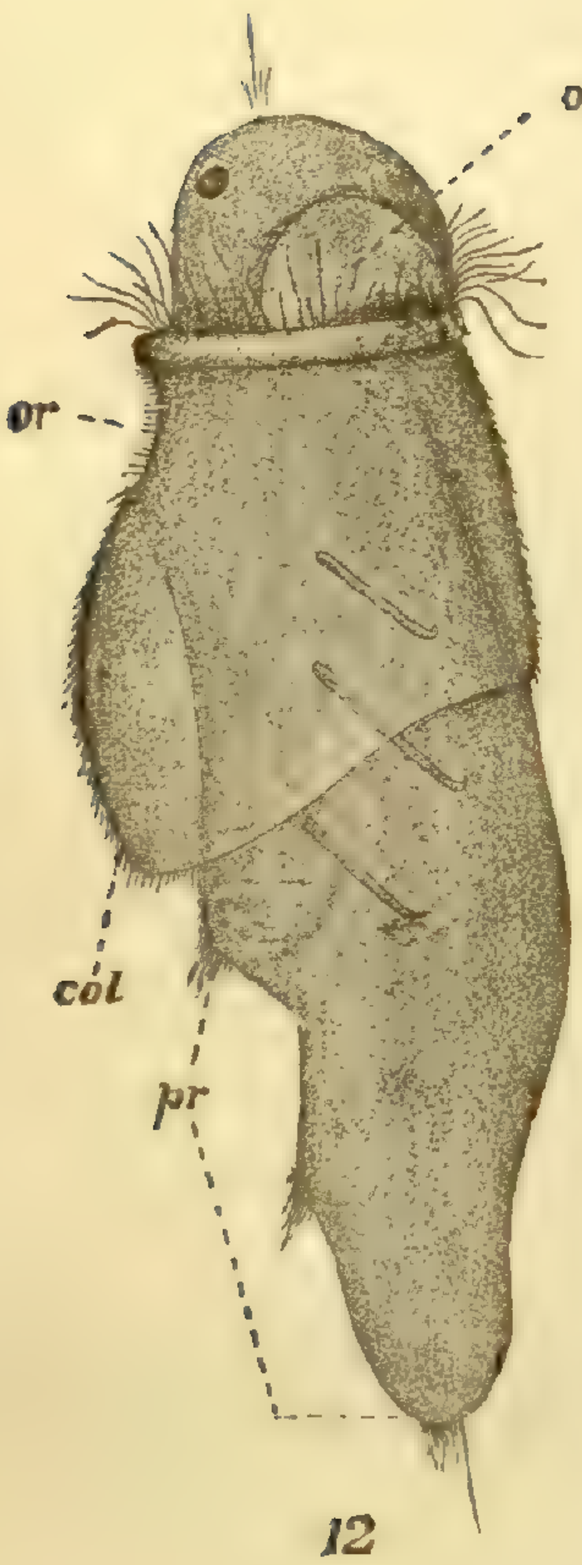
The free larva seen from the ventral side is represented in Fig. 10. It is easily detected in the water on account of its reddish color, although its size is not more than 1^{mm} in length. The larva is more elongated and more vermiform than in previous conditions, and the middle body region is relatively much larger than formerly. It is no longer bounded posteriorly by the posterior edge of the collar.

The head bears four[1] eye spots; two larger, the original ocelli (*oc*), and two small, which are apical, dorsally and medially placed. There is an apical tuft of cilia. The cilia of the belt, between the head and body, are borne on a ferrule-shaped structure which separates the head from the middle body region, and which bears a small ring of cilia on its posterior, a larger on its anterior edge. The mouth opens medially just below this ferrule and above the base of the ventral collar. Its lips are richly ciliated. The ventral collar covers about one-third the middle body region, which is not segmented and bears three pairs of single spines which are falciform at their free extremity. The middle region may be homologized with the anterior body region of such a worm as Prionospio.

The posterior body region is of smaller diameter than the middle and is obscurely segmented. It is ciliated on the ventral side, a prominent ring, "couronne ciliaire abdominale," being formed on the segment nearest the middle division. The posterior extremity of the larva is richly ciliated and bears several short stiff hairs. The whole body cavity, with the exception of that found in the posterior region, has a brick red color. When this larva is seen in profile it will be noticed that the external surface of the collar is ciliated over its whole extent, and that the prominent red projection on the ventral surface of the middle region is also

[1] Pagenstecher says (*op. cit*, p. 492): "Um diese Zeit bilden sich aus einigen Zellen der äusseren Schicht des vordersten Lappens vier Augenpunkte, von denen die hinteren grösser sind, und auf der Mitte der Stirn wachst eine erst ungemein Classe gerade Borste hervor."

A. Agassiz says: "The ocular spots are always limited to two." The larvæ which I have studied have four and a median flagellum, as described by Pagenstecher.



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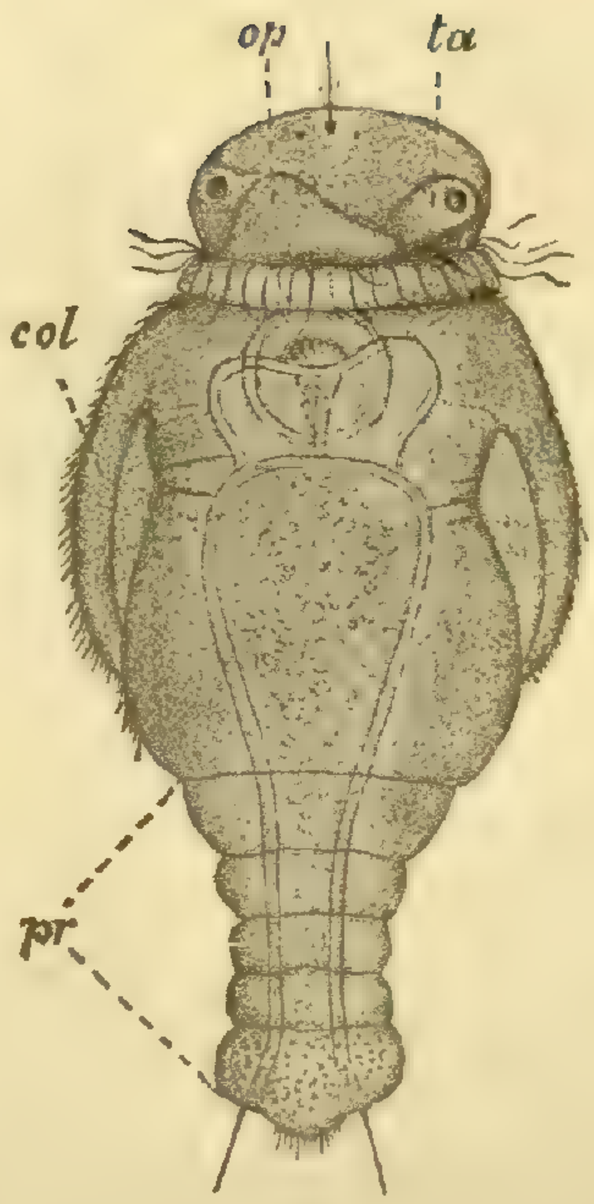

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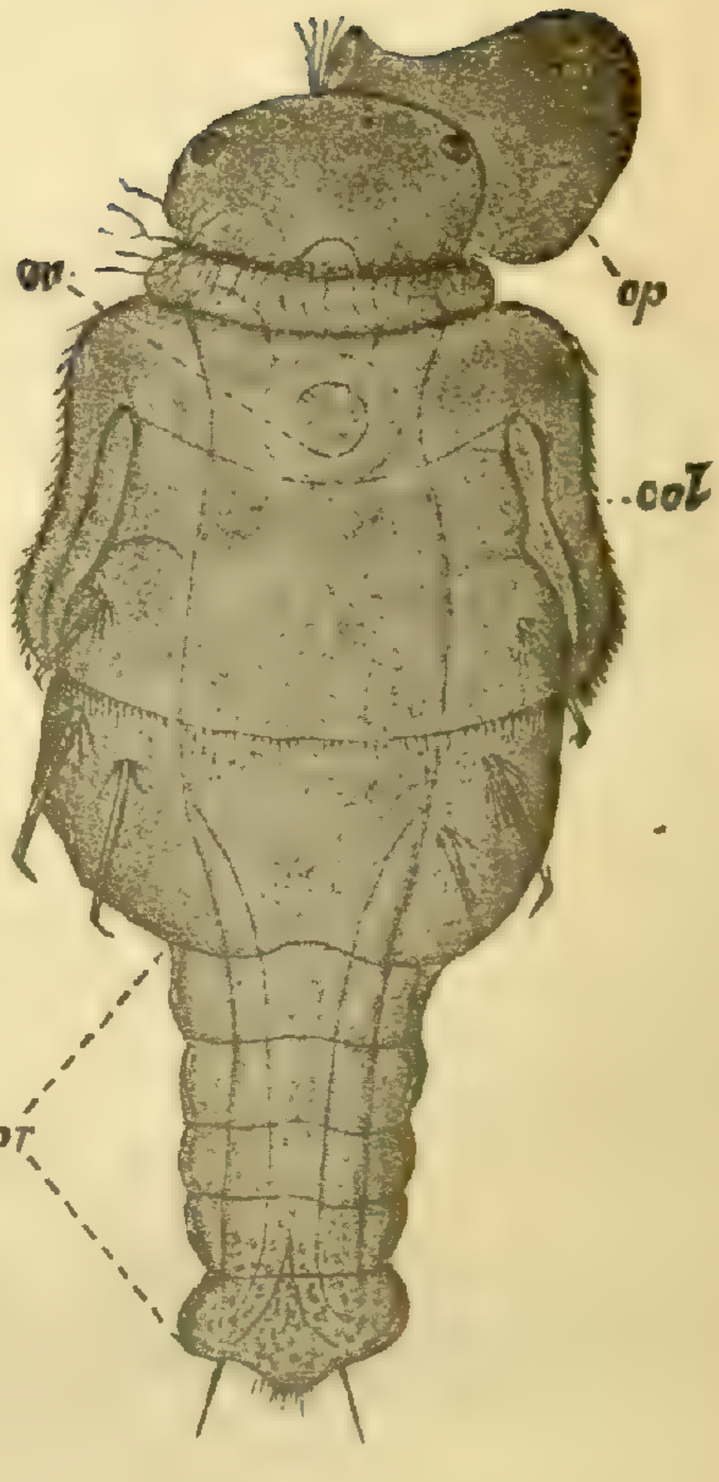

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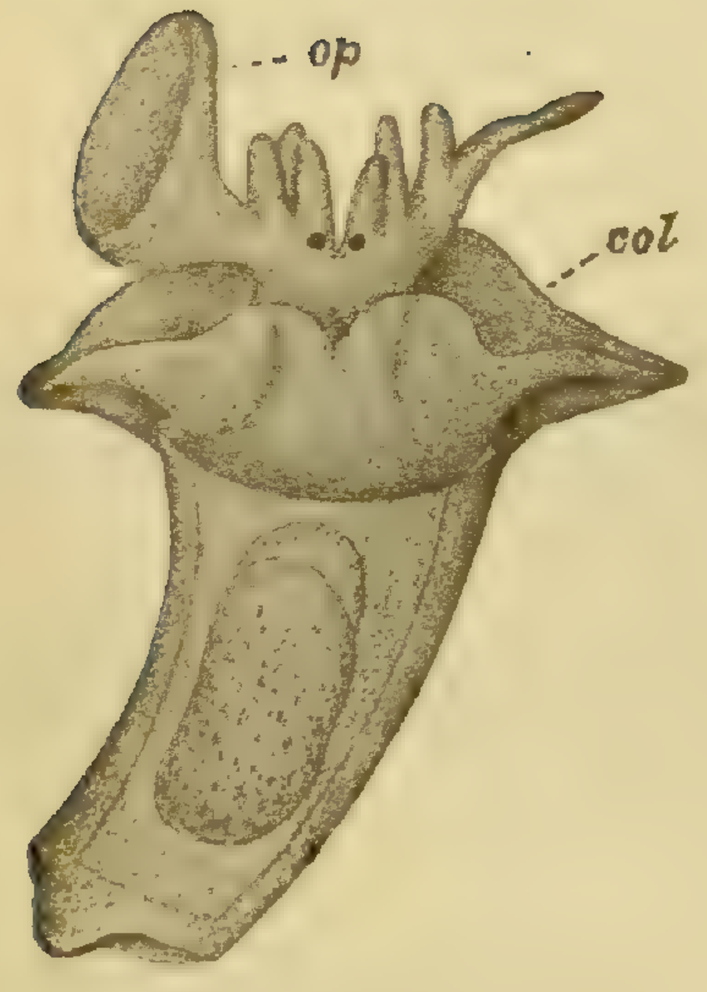

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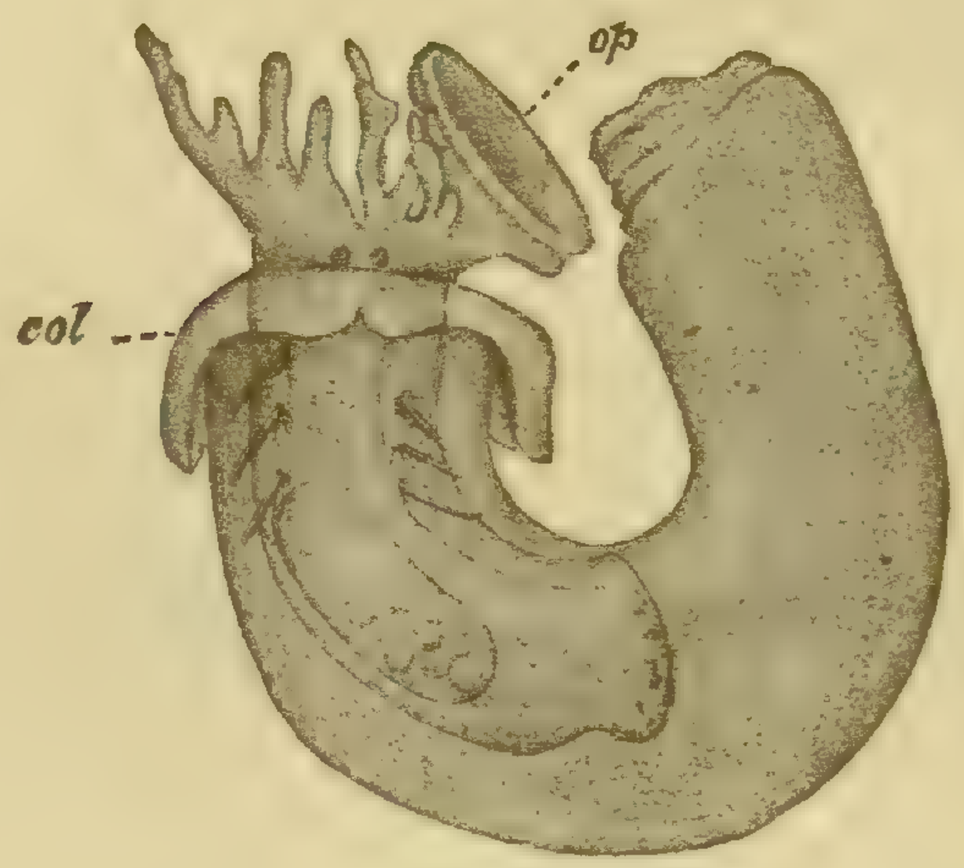

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Larval forms of *Spirorbis borealis*.

covered with cilia. Midway between this last and the posterior extremity of the body is a second prominent tuft, and the very end has a third. Besides these three ciliated regions the whole ventral surface of the posterior part of the body of the larva is clothed with small cilia.

If the cephalic region of the last mentioned larva be looked at from one side (Fig. 12), it will be noticed that on the left hand side of it, snugly approximated to the dorsal walls of the head, there is a thin triangular plate which has begun to push itself up from the region just in advance of the ferrule-like structure upon which the ring of larger cilia is borne. This structure which at first grows out from the left hand side of the neck, and is unpaired is the future operculum.[1] At the time of its origin it is small, and in all stages unpaired, while later in the growth of the worm it assumes a considerable size.

The first appendage to form on the right hand side (Fig. 11) of the larva is a small tentacle, short, stout and club-shaped. I do not find another similar tentacle on the left hand side, but it it exists it may be hidden by the operculum. The better interpretation, however, is, that the operculum where it originates has the form of a simple tentacle with which it is strictly homologous; while the size of the operculum as it grows increases so greatly that it far outmeasures that of the right hand tentacle. My observations do not lead me to think that the tentacles form alternately on the sides of the head of this species of Spirorbis.

Fig. 13 represents a slightly older larva seen from the dorsal side, in which the segmentation of the posterior body region is more sharply defined, and in which also the operculum (*op*) and the right hand tentacle (*ta*) are well developed. In Fig. 14 we have the same larva much older, shown from the ventral side, where the operculum is represented as expanded on the left hand side of the head. In most particulars this larva closely resembles the free larva (Fig. 10).

In a stage which is older than the last the larva has passed into a condition in which not only has the operculum assumed a considerable size, but also several small appendages are found on the head, while of the organs of the head which have disap-

[1] In *S. spirillum*, according to A. Agassiz, "the first tentacle appears on the right, next comes the corresponding tentacle of the left, and only later the rudiment of the odd opercular tentacle covering in figure 21 the right tentacle." The operculum was the first cephalic appendage which was observed in the larvæ which I studied.

peared, the most important is a pair of the ocelli, the first to originate and for a long time the most prominent eye spots found on the ventral cephalic prominences. The apical ciliated tuft of former stages has also disappeared. The apical eye spots still remain.

Of the appendages to the head we notice on the right hand side instead of the club-shaped tentacle which formerly existed there, that the place is now occupied by an elongated body with beginnings of side branches, a structure which later forms a branchia. On the left hand side, near the operculum, are small projections which later develop into the left hand branchia, while medially appear two prominences, one upon the other. In the development of the larva of Spirorbis it looks as if we had, as I have already shown,[1] in a larva which is provisionally identified as the immature Prionospio, and as Salensky has found in Pileolaria, temporary cephalic tentacles which later give place to the permanent branchiæ of the head. In the right hand branchia, now of considerable size, we formerly had a small tentacle which, although it never reaches the great size of the temporary tentacle of Prionospio, is so closely similar both in size and general appearance to the temporary tentacle of Pileolaria, as described by Salensky, that it is in Spirorbis placed in the same category.[2]

The passage of the free larva of Spirorbis into the form with a case is a most interesting process, and one which is by no means simply in the changes involved. It can easily be observed in early conditions and the interior even of the larva studied, since the external case, when first formed, is almost wholly transparent.

At this age the larva becomes attached to the walls of the vessel in which it is confined preparatory to the secretion of a shell. In many specimens, however, the following condition, which although probably abnormal, was most advantageous to a study of the secretion of the tube, was observed. The free larva often

[1] Bull. Mus. Comp. Zoöl., Vol. XI, No. 9.

[2] I do not consider that the worm represented in fig. 57 of A. Agassiz's paper (*op. cit.*) is, when compared with fig. 56, an instance of retrograde development. Fig. 57 bears a strong likeness to *Alaurina prolifera* commonly looked upon not as an annelid but as a turbellarian. If the worm is an Alaurina I cannot regard the larva represented in fig. 56 as its young. The adult of fig. 56 is unknown, and it is extremely doubtful that it ever loses its cephalic spines and appendages and passes into fig. 57. It may or may not resemble Prionospio in a subsequent modification of the cephalic tentacles into branchiæ.

does not immediately settle to the bottom prior to the secretion of the case in which it lives, but passes through preliminary stages while floating on the water. Upon the surface of my aquaria, with its Spirorbis, I found a multitude of small white bodies, unattached, which on close examination were found to be Spirorbis larvæ in which the shell had just begun to be secreted. They float on the surface for a short time until the increasing specific gravity of their bodies sinks them to their future homes.

Fig. 15 represents an example of a larva of this kind in which the head and collar is half protruded outside of the cavity of the case in which the larva is found. The head and branchial appendages occupy the middle of the figure at the top, while the expanded trumpet-shaped structure below it is the half protruded collar. It is extremely difficult to draw accurately the outlines of a specimen of Spirorbis in this stage when wholly or partially expanded and alive, from the fact that the movements are so quick in retracting itself into the case, and the animal is so sensitive to any small motion in the immediate vicinity. It has been almost impossible for me to observe the expanded Spirorbis long enough to draw anything more than a simple outline with the camera. This difficulty increased with the growth in age of Spirorbis.

The case or shell of the larva, Fig. 15, is not at first coiled, but slightly curved, horn-shaped, well formed at its larger end, with less solid walls at the smaller extremity. The most prominent structure in the body of the larva is an oblong mass of cells of brick red color seen through the transparent walls of the shell. In the next stage (Fig. 16) which was also found floating on the surface of the water, the shell has elongated and become partially coiled, but is still transparent and in places more or less flexible in character. The larva now occupies not more than one-half of the whole length of the case when the appendages to the head are expanded. Fig. 16 represents this larva taken on the surface of the water prior to attaching itself to some foreign object. The branchial appendages to the head are more completely developed in this than in previous conditions in the growth of Spirorbis. The ciliation upon them is also more conspicuous than in previous embryos. The operculum is represented on the right hand side of the figure.

The collar, which when the head is extended from the case, is reflexed over the edge of the shell, is clothed with minute cilia. As in previous larvæ, drawings are very difficult to make on account of the quick motion in the retraction of the head, in this the difficulties are even greater. A camera drawing of the case is, however, very easy to obtain from its more solid nature. The soft parts were taken from a specimen which was dead, but not distorted by the conservative fluids in which it was preserved,

On the body of the worm three pairs of spines, which are hook-shaped at their extremities and connected with the body walls by strong muscles, were observed. These spines are placed as in early stages upon the anterior body region, and are very prominent. The posterior body region is destitute of spines in this stage. One of the most conspicuous structures in the body of the worm is a large oblong mass, of reddish color, easily seen through the transparent walls of the case which encloses the worm. The size of the worm is 2^{mm} measured from one side of the coiled case to the opposite side.

EXPLANATION OF THE FIGURES.

cap, capsule in which the embryo is enclosed.
cs, covering in which the "strings" of ova are found.
cil, cilia.
col, collar.
eb, epiblast.
mb, mesoblast.
oc, ocellus.
op, operculum.
or, mouth.
pj, projections which later grow together and form the collar.
pr, posterior body region.
ta, tentacle.

PLATE XI.

FIG. 1.—The terminal egg of a string in its capsule after segmentation and formation of layers and cilia. Larva in capsule and chain.

(Figs. 2–4, the same embryo still in capsule older than the last.)

" 2.—Lateral view.

" 3.—From posterior pole. Larva in capsule and chain.

" 4.—From ventral side.

(Figs. 5–7, still older larva.)

" 5.—Lateral view.

" 6.—Ventral view.

" 7.—View from anterior pole.

" 8.—Lateral view of a larva slightly more mature than the last.

" 9.—Older larva from ventral surface just before escape from its capsule. Terminal larva in the chain.

FIG. 10.—Free young captured on surface of the water in glass jar containing specimens of the adult. Size 1mm.

" 11.—View of the head of a young Spirorbis older than the last with the beginning of the operculum and the right hand tentacle, seen from the dorsal side.

PLATE XII.

FIG. 12.—Side view of a larva of the same age.

" 13.—The same larva older, seen from the dorsal side.

" 14.—An older larva seen from the ventral side.

" 15.—Larval Spirorbis which has just begun to secrete its shell, shown with the collar and head partly protruded.

" 16.—An older larva with shell more completely formed than in the last. The head and collar are extruded. Size 2mm.

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PENNSYLVANIA BEFORE AND AFTER THE ELEVATION OF THE APPALACHIAN MOUNTAINS, A STUDY IN DYNAMICAL GEOLOGY.

BY PROFESSOR E. W. CLAYPOLE.

THE geologist traveling or working among the contorted strata of Pennsylvania can scarcely escape being struck by the immense compression which the rocks of that part of the country experienced during the folding process which was the first stage in the formation of its mountain ranges. By this term I do not mean merely the condensation of the rock-masses by the tangential pressure to which the folds are due, but the actual shortening of the surface which must have resulted from the folding.

Doubtless the thought has occurred to others, but I do not recollect seeing it put forward or developed to its legitimate conclusions. Yet it is obvious that so extensive a corrugation of the earth's crust manifesting itself by the production of several wide anticlinal arches, from which the present mountains have been carved, must have been accompanied by a diminution of the area over which those strata previously extended.

To measure as nearly as practicable the extent of this contraction of the surface and to set forth the more important conclusions deducible therefrom are the objects of this paper.[1]

To prevent undue extension in treating the subject, it will be necessary to assume certain propositions. These will be here

[1] An abstract of this paper was read before the British Association at Montreal in August, 1884.

mentioned. They are, I think, now fully accepted by all dynamical geologists.

1. That cooling and consequent shrinkage taking place in the earth's heated interior, must produce and have produced tangential pressure in the hardened and cooled crust.

2. That this tangential pressure overcoming the rigidity of the crust has produced deformation or crumpling.

3. That this crumpling of the strata was the first and leading factor in the production of mountain-ranges which have been carved by meteoric action out of the folds this produced.

4. That the folds out of which the Appalachian mountains have been carved were formed during the later part of the Palæozoic era.

Yet further to limit the subject and bring it within the bounds of practicable treatment, another exclusion must be made. Middle Pennsylvania, from Harrisburg to Pittsburgh, is occupied by an almost continuous succession of arches of the folded Palæozoic rocks. Some of these are closely pressed, others are more open, some are long, ranging for many miles from north-east to south-west, others run only a few miles. Some involve a great breadth of country, others extend over only a few hundred yards. To take account of all these is impossible. The geography and geology of the State are not yet sufficiently known to supply the details, and the space at command is too small to discuss them if supplied. I therefore propose to omit all the less important ones and to consider only the leading mountain ranges of Appalachian Pennsylvania.

The number of these varies in different places, but not so as to seriously affect the results sought. Thirteen principal ridges traverse the middle of the State from north-east to south-west. All these may be cut by a line drawn from a point near Warrior's Mark in Huntingdon county, to another ten miles south-west of Carlisle.

These thirteen ranges are the following:

13. Allegheny mountain.
12. Bald Eagle "
11. Tussey "
10. Standing Stone "
9. Jacks "
8. Blue Ridge.
7. Black Log "
6. West Shade mountain.
5. Tuscarora "
4. Conecocheague "
3. Bower "
2. Blue "
1. South "

Section across Middle Pennsylvania, showing amount of compression of surface.

From this list I shall exclude the first because it consists in great part of gneissic rocks whose bedding is doubtful and difficult of detection, and the thirteenth because its strata are of later date than those of the other ranges. There remain, therefore, for discussion eleven distinct mountains, rudely parallel, and, for Pennsylvania, of the first order. To prevent misconception or objection I should state that all these ranges are composed, medially, of the same rock—the massive Medina sandstone—the base of the Silurian system proper in Pennsylvania. The possible error of counting the same dip more than once is, by this fact, evaded.

The line of section above mentioned is sixty-five miles long, and may be divided naturally into two parts. One extends from its north-western end to the Blue mountains, and the other from the Blue mountains to its south-eastern end. The first division is forty-nine miles long and crosses all the eleven ranges of mountains above named. The second is sixteen miles long, and crosses only the Cumberland valley.

The line lies in six counties, among which it is distributed as follows:

Blair	2 miles.
Huntingdon	24 "
Mifflin	6 "
Juniata	8 "
Perry	9 "
Cumberland	16 "
	65

The accompanying plan exhibits the relation of the eleven ranges to one another, and the section shews the position of the bed of Medina sandstone which forms the axis of each.

The problem is now reduced to finding the length of the line representing this bed of sandstone in its present contorted condition, for that must represent, approximately at least, its original extent when spread out flat.

Taking first its north-western portion forty-nine miles in length I have drawn it as nearly as possible to scale on the accompanying diagram. I propose now to make a deduction of twenty miles for the flattish tops of the arches and bottoms of the troughs—an allowance which is, I think, in excess of the truth. This deduction leaves twenty-nine miles of strata, dipping more or less steeply, often standing nearly vertical, sometimes over-

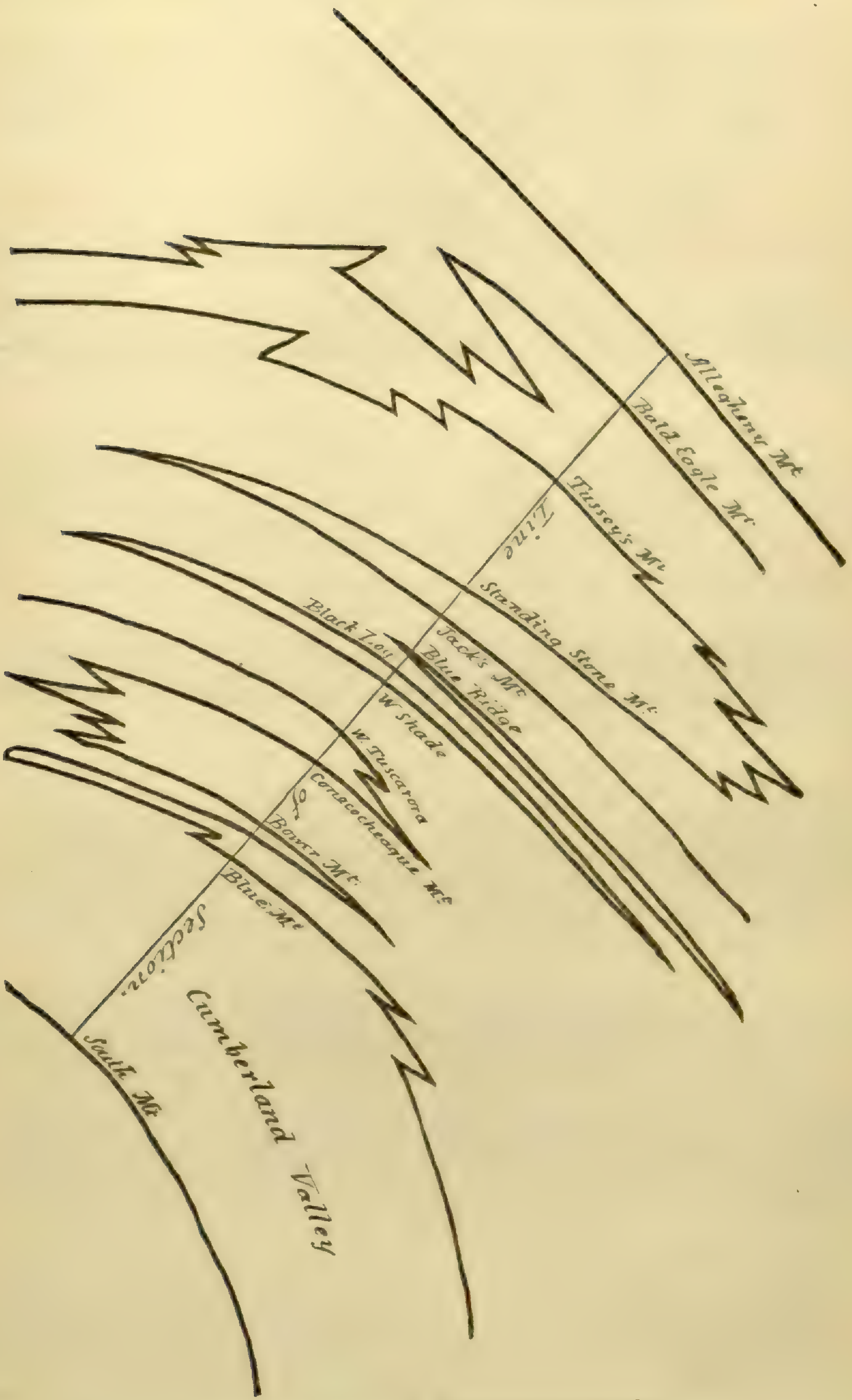
thrown and probably at most exposures approaching or exceeding a dip of 45°. Over this distance I propose to assume an average dip of 40°, which to me seems fairly to represent the facts and to be rather below than above the truth. A simple calculation then proves that these twenty-nine miles of strata, if flattened out, would measure about thirty-eight miles.

If from the accompanying section the distances representing these twenty-nine miles are taken out and measured by the scale, a result in close agreement with the above will be obtained. The two confirm each other.

In regard to the Cumberland valley the problem is more difficult. South of the Blue mountain the structure of the country is very different. Here the Medina sandstone is lost, having been entirely removed by erosion, and we are consequently compelled to adopt another stratum. The valley consists entirely of Cambro-Silurian limestone and slate dipping steeply, and the latter showing strongly developed cleavage. On the north-western sides of the arches the strata are usually inverted. It is evident at once that compression has here been much greater and the tangential compressing force much more intense than along the other portion of the line. Professor Rogers says in the Geological Survey of Pennsylvania (Vol. I, p. 240):

"The dip of the south-eastern leg of the arch is from 45° to 60°, while that of the north-western inverted side is from 60° to 80°." "The formations repeat themselves in several narrow, short and parallel anticlinal and synclinal outcrops. They are folded into a very uniform steep south-eastern dip in a series of compressed flexures, readily discernible on the Cumberland Valley Railroad. Along the south-eastern margin of the valley so general is the inversion of the folded limestone that this formation appears everywhere to dip under the primal rocks of the South mountains, and had we not fully established their true position we might imagine the former to be the lower or older group" (p. 1113).

Adopting Professor Rogers's figures, it is clear that the results obtainable from the Cumberland valley must far exceed in proportion those above given from the counties lying farther to the north-west. The dips above stated show that the inverted sides of the arches altogether underlie the others, and the measurements obtained for them must therefore be added to those found for the south-eastern or uninverted sides. The latter will be first considered.



Mountain Ranges of Middle Pennsylvania.

In consequence of the condition of the strata it is exceedingly difficult to determine in the field the number of folds occurring in the valley. It is not probable, moreover, that they are regular or constant. The beds involved are, however, about a mile in thickness, so that there can scarcely be less than eight arches in the sixteen miles. If then for the south-eastern legs we adopt Professor Rogers's lowest angle of dip, or 45°, and for the north-western sides his lowest estimate, or 60°, and plat these to scale, we have the following result:

The Cumberland valley, sixteen miles wide, consists of at least eight overthrown anticlinal arches, the crest of each of which overlaps to some extent the base of that following it. This will be clear from an inspection of the diagram, where a single bed of rock is shown folded as required by the conditions above given. *A B C*, &c., are the successive crests of the arches formed by the stratum. *X Y* represents the present surface of the ground. *a b c* are the bases of the synclines corresponding to the arches. Taking into consideration the mid-layer of the stratum represented by *Q O S T U V*, &c., which will represent the actual length of the folded bed, a short mathematical calculation will prove that *O Q* is 3.3 times as long as *R Q*. *R Q* representing one mile, *O N* will therefore represent 6.6 miles. All the eight south-eastern legs of the arches will consequently measure about fifty-two miles.

In like manner we find that the length of the line *O R*, compared with *R Q*, is 2.7. Consequently the length of the line *O S* represents 5.4 miles and the eight north-western sides of the arches amount to forty-three miles.

Again, a reference to the figure will show that the north-western side of each arch underlies its south-eastern side, so that its whole length must be added to the figures previously obtained.

Summing up results, we find:

Twenty-nine miles at 40° dip, or	38	miles.
Eight anticlinal arches in Cumberland valley—		
South-eastern sides	52	"
North-western sides	43	"
Add twenty miles for flat strata, as previously deducted	20	"
Total	153	"

In other terms this means that a tract of the earth's surface measuring originally 153 miles from south-east to north-west has

been so crushed and compressed that its present breadth along the line of section is only sixty-five miles. Of this shortening the greater part has been suffered by the Cumberland valley, where ninety-five miles of country have been compressed into sixteen miles.

The diagram shows the distribution of the compression among the different counties. Approximately it may be represented by the following figures:

ORIGINAL AND PRESENT EXTENT OF THE COUNTIES ALONG THE LINE OF SECTION.

	Original extent.	Present extent.
Blair	2 miles.	2 miles.
Huntingdon	26 "	24 "
Mifflin	8 "	6 "
Juniata	10 "	8 "
Perry	12 "	9 "
	58	49
Cumberland	95 "	16 "
	153 "	65 "

These facts may be thus expressed. During the compression and corrugation of the crust to which the mountains of Pennsylvania owe their origin, the south-east line of Huntingdon county was moved forward two miles, that of Mifflin four miles, that of Juniata six miles, that of Perry nine miles and that of Cumberland eighty-eight miles. Consequently the whole of Mifflin county was shoved, at the least, two miles to the north-west, the whole of Juniata county four miles, the whole of Perry county six miles and the whole of Cumberland county nine miles over the underlying deeper strata. The possibility, still less the reality, of mass-motion of this kind and to this extent, has not, it seems to me, been generally recognized by geologists.

The movement of course diminished toward the north-west in consequence of the increasing resistance offered by the increasing load, and came at length to nothing beyond the limits of Pennsylvania. Ohio was the great buffer-plate against which this tremendous earth-force spent itself. The south-eastern portion of the district—the Cumberland valley—and even probably some considerable area beyond it to the south-east felt its first and mightiest pressure. There the strata were crumpled, bent, crushed and thereby thickened until it became easier to shove them bodily forward than to bend them again. They were consequently added

PLATE XV.

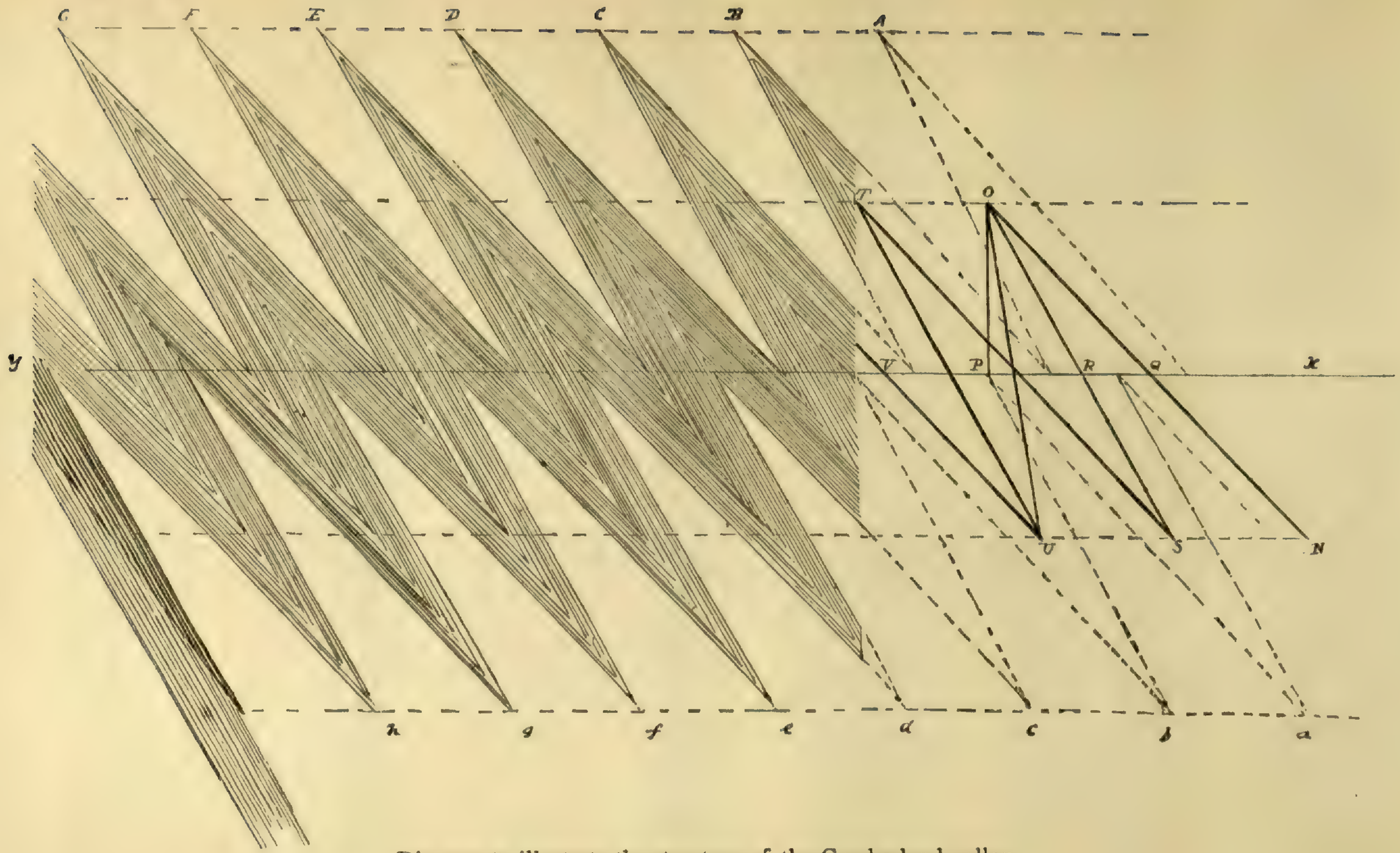


Diagram to illustrate the structure of the Cumberland valley.

as a snow-plough in front of the mighty engine, and in their turn communicated the movement and the crumpling to the north-western country beyond them.

It is possible that considerable correction might be made in these figures if more accurate details of structure were attainable. This correction might be in either direction. That it would not all tend to diminish the result seems clear from the following considerations:

(1) No account is taken of the condensation of the strata during compression.

(2) The line of section does not pass through the most distorted district.

(3) All effects of compression in and beyond the South mountain and west of the Bald Eagle range are disregarded.

(4) The summits of the arches and the bottoms of the troughs are assumed to be, but are not quite flat.

(5) No account is taken of numerous intermediate minor folds or of several faults, at some of which the older strata to the south-east have been shoved *uphill* over the edge of the newer north-western beds at an angle which observation does not yet enable us to determine.

On the other hand the height of the creases in the Cumberland valley may be somewhat less than that shown in the diagram and assumed in the calculation. All these minor considerations cannot affect the main point at issue. The figures above given indicate a compression of the superficial layer of the crust in Pennsylvania during the process of crumpling by which eighty-eight miles of the surface have disappeared, sixty-five miles at present being all that remain from a former breadth of 153 miles. Even if only one-half of these figures be taken into account, the problem remains equally difficult. How can such a shortening of the surface be accounted for?

We are at no loss for a force competent to produce it. The tangential pressure developed by a contracting nucleus under a solid crust is amply sufficient to deform and corrugate that crust. But to realize the effect which this tangential pressure has produced is less easy.

A shortening of the circumference by eighty-eight miles is equivalent to a shortening of the diameter of the earth by about twenty-seven miles. Are we prepared to admit that the globe

actually contracted to that extent during the formation of the Appalachian earth-folds? If not, how shall the facts above stated be explained?

The suggestion has been made that the subsidence of the present bed of the Atlantic from a continental level in late Palæozoic days may have supplied the necessary compressing force and have produced the shortening here pointed out. But the cause is totally inadequate. Supposing that the whole Atlantic area had subsided from the mean height of one mile above sea-level to five miles below it at its middle or deepest point—a maximum supposition—then a short calculation will prove that the new and flattened arc so produced, of 60° in extent, would measure only about three miles less than the previously existing one. This amount, if wholly expended in crushing the thick Appalachian sediments, would evidently be far from sufficient for the solution of our problem.

Without therefore denying the occurrence of such a subsidence, we can lay it out of the case as inadequate.

Is it possible to believe that there was an accumulation of strain on the crust during preceding ages, which was relieved by the occurrence of this paroxysmal compression and corrugation. Such a supposition would meet with strong opponents in many quarters.

Mathematicians tell us that the crust cannot endure the strain which would be caused by the shrinking away of the nucleus in consequence of contraction, but must close down at once upon the latter as it sinks. Some of them add that this would be the case were it many times as resistent as now. If so, any such accumulation of strain is evidently impossible.

But there is a possibility that the interior of the earth may be of such a nature as to allow of some considerable amount of shrinkage without leaving the crust completely unsupported. This partial support might enable contraction to proceed for some time before the closure of the crust upon the shrinking nucleus followed. A cellular structure about the place of junction between the cool and heated portion might render possible such a condition of things. Our ignorance of the earth's interior is at present so dense that any supposition which does not clash with well established facts is admissible for the purpose of argument.[1]

[1] In this connection I may remark that since writing the above passage I find that

The mathematical solution of geological problems such as that now under consideration is far from being satisfactory to geologists. Without in the least undervaluing the labors of the many eminent mathematicians who have taken the subject in hand, I may plainly assert that the conditions are yet too little known to enable them to apply their processes with complete success. The mill grinds out its meal according to the nature of the grist supplied, but cannot change its quality. So the mathematical engine, of whatever kind, works out its conclusions from the premises given. If these are full and true the results cannot be false. But if these are insufficient and half unknown, or if any of them are much limited and modified, the results are to an uncertain extent invalidated. This is the case with almost all investigations dealing with the condition of the earth's interior. In order to bring them within the grasp of mathematical formulas the data of the problem are narrowed down or altered to so great a degree that the conclusion, though true for these, is false for the actual data. A logical fallacy lurks in the argument. The reasoning deals with an imaginary earth possessing certain comparatively simple characters. The conclusion when obtained is applied to the real earth, whose characters are much more complicated. The confusion lies in the employment of the term "earth" in two different senses—a logical fallacy of the first magnitude, and one whose insinuation into any geological problem must be avoided with the utmost care if conclusions of value are anticipated.

Hence without any expressed or implied disrespect to the mathematician, the geologist may receive his arguments on geo-

Dr. T. Sterry Hunt has recently, in the discussion of a different subject, put forward some views which deserve mention in this connection, and may not be without bearing upon the matter in hand. He has dwelt strongly on the universally crumpled condition of the metamorphic rocks, and has suggested that in the early days, when these strata were deposited, enormous quantities of matter were removed by the action of springs from the interior to the outside of the earth. This removal must have left cavities below, into which the crust sank, and in sinking became thus universally corrugated. This he calls the *crenitic* theory of metamorphism. It is obvious that Dr. Hunt's suggestion is in line with that above made, though the phenomena to be explained are much earlier in date and consequently in a more obscure and debatable region. Much less is known of the date and mode of formation of ranges of metamorphic strata than of the Appalachian mountains. What is supposable at one stage need not, however, be absurd at another, and I am glad to be able to quote Dr. Hunt's words, even if only in a slight degree conveying a suggestion similar to my own.

logical problems with great reserve. While he welcomes all aid from this quarter for his difficult tasks, he should not allow a mathematical deduction of the kind above mentioned to prevent his acceptance of a contradictory physical deduction from observed facts. If the latter warrant any inference out of harmony with the former, there is at least a possibility that the latter may be right. And in our discussions regarding the interior of the earth we are in this condition. The data of the problem are as yet too obscure and uncertain for the mathematical engine, and physical deductions from observation claim and deserve at least equal consideration.

If then the facts here detailed justify the interpretation put upon them, they lead to conclusions which, if admitted by a few geologists, have certainly not been generally asserted. If these indications of contraction are acknowledged to the full extent here given, or even to any considerable portion of that extent, they require admissions and lead to conclusions for which all are not prepared, and to which not a few will be strongly opposed. If the eastern seaboard of North America has, by tangential pressure, been shortened so that a line originally 153 miles long now measures only sixty-five miles, the circumference of the earth must be lessened to that extent. Consequently the admission of the statement here made involves an admission that the diameter of the earth was diminished by about one-third of this amount, or that its radius was shortened thirteen miles by contraction during the later part of the Palæozoic era. Geology is not fully prepared for this conclusion, and astronomy is perhaps less ready for it. Yet, unless one or the other can find some better explanation, the unwillingness to admit is not a sufficient reason for rejecting it.

It is not the object of this paper to consider and discuss the various objections that must arise to the conclusion above stated. And such discussion would require more space than can be here occupied. A few words in conclusion must suffice.

Possibly, though in treading on so uncertain a ground and in so dim a light I wish to advance with the greatest caution, aware that every step may be in the wrong direction, yet possibly there are indications to be found elsewhere which may render the inference above drawn a little less startling, even if they do not bring it within the bounds of ready credibility. Spasmodic action with

intervals of repose is a usual mode of operation in nature. Without going back to earlier days, whose events are more obscure, I will consider only the later geological history of our globe. And here are not wanting evidences of similar changes. Admitting that cooling and consequent internal contraction have been, by physical necessity, continuous, there seem to be indications that the subsequent corrugation of the crust has been to some extent spasmodic. Beyond doubt the formation of arches and troughs by compression of the strata has occurred in almost every era. Perhaps when we know the whole earth we may find no time of perfect repose. But since the Palæozoic era ended there has been at least one period during which the process again rose into great prominence, eclipsing perhaps that which it exhibited in Palæozoic days. Anticlinal arches can be found of almost every date in Secondary time. But after the beginning of the Tertiary age, and through a great part of its duration, their development became wonderful. Almost all the great mountain ranges date from this era. Strip from the earth the mountains of Tertiary date and it would lose nearly all its grandest features, and would be reduced to a comparatively monotonous plain. The Rocky mountains and the Andes in the western world, and in the east the Alps, the Apennines, the Pyrenees, the Carpathians and the Himalayas, with other minor chains, all date back to about Mid-tertiary days. And the elevation of so many lofty anticlinal folds, in comparatively a short time, threw into the shade all events of the kind that had occurred since the great Appalachian revolution. It is not yet possible to estimate, still less to measure, the folds of these ranges, but it impossible to doubt that they would yield results scarcely less, and perhaps greater, than those which I have given for Pennsylvania.

What then must be our conclusion? Must we incline to the belief that our earth has much diminished in size since the middle of Palæozoic time? Must we admit that this diminution amounts to many miles? That the radius is thirteen miles shorter than it then was, and the circumference less by six times that amount? Apparently there is no escape.

One word more. Is not the admission reasonable? Is not the denial unreasonable? If the earth is a cooling and contracting globe the result must surely be evident in the long ages that have elapsed since the Appalachian earth-folds arose. If the corru-

gation due to contraction in that interval is inappreciable, what an enormous time must be allotted to the earlier stages of geological history! Even allowing for a greater rate of cooling in those earlier days, the time will surpass all that geologists have demanded, and be more difficult of admission than the contraction here contended for. It is not easy to admit that cooling, contraction and crumpling have been important factors in the formation of the surface of our globe, and at the same time to deny that their action has been perceptible or important since Mid-palæozoic ages, that is during a lapse of time amounting probably to not less than fifteen millions of years.

Further, it is not impossible or improbable that the facts and inferences here detailed may be useful in the solution of some difficult geological problems, especially regarding the older rocks. If mass-motion to so great an extent has taken place in the earth's crust since Palæozoic time began—if the tangential thrust has produced lateral movements in the rocks such as those here described and others which might have been mentioned—if strata have slid bodily over strata for great distances, and whole counties have been shoved for miles out of their previous places, it is obvious that enormous lateral displacement of strata must be recognized as a momentous factor in geology, and that older beds may be found far out of their expected places and even overlying newer ones. Into this subject, however, I cannot now enter, but leave it with the single remark that the greatest caution and reserve must be manifested and every element of doubt eliminated before we can confidently assert that in regions of disturbance the *upper* is the *later* deposit.

I may be allowed to repeat in conclusion that the inferences here deduced do not rest on exact accuracy in the figures employed. Were they considerably in excess of the truth the argument would still hold good. Even the half of the amount of contraction involved would far surpass what geologists have been in the habit of claiming or astronomers of allowing.

LIFE AND NATURE IN SOUTHERN LABRADOR.

BY A. S. PACKARD.

THE following recollections of our student days are offered with the suggestion that our college boys of the present day might spend to advantage the long summer vacation in cruising on our northern coasts, and combine in agreeable proportions science and travel.

In the summer of 1860, while a student in Bowdoin College, I joined the Williams College expedition to Labrador and Greenland under the charge of Professor P. A. Chadbourne. June 27th found us on board the *Nautilus*, a staunch schooner of about 140 tons, commanded by Capt. Randlett. Soon after five o'clock of a bright fresh morning our vessel cast off from the wharf at Thomaston, Me. The Thomaston band played a lively air, a clergyman made a parting address, calling down the blessings of heaven upon the argonauts; our Nestor replied, the students cheering for the citizens of Thomaston and the band, and with a favoring north-west wind the *Nautilus*, gliding down the current of the St. George's river, a deep fiord, in a couple of hours reached the open sea.

Our course lay inside of Monhegan, with its high, bold sea wall. Passing on, the Camden hills recede, and we endeavor with the glass to make out the White mountains, said by some to have been seen by Weymouth from inside of Monhegan. The ocean swell not being conducive to historical controversy, we turn to watch the Mother Carey's chickens and the grampus as well as the fin-back whales sporting in the waves.

By the next morning we had sailed 190 miles from Thomaston, past Cape Sable, and our north-west wind still attending, we bowl along, through schools of porpoise, while two or three whales pass within a few fathoms of our vessel, showing their huge whitish backs. The next day our seven-knot breeze does not fail us, and takes us by the 30th into a region of light winds and calms off the Gut of Canso.

July 1st we sail along Cape Breton island, its red shores glistening in the noon-day sun and then mantled with purple as the sun goes down over Louisbourg. As darkness sets in the lights of Sidney appear. The next morning's sun rose on Cape Ray, around which we beat, passing within a mile of Channels, a fish-

ing village of Newfoundland, behind which rise steep hills clothed with "tucking-bush," or dwarf spruce and larch. Cape Ray pushes boldly into the sea, its precipitous sides of decomposed sandstone furrowed by the rains which pour down its scarred cheeks, on which still linger banks of the last winter's snows.

By the next evening we pass Cape St. Georges. The 4th was celebrated in the Gulf of St. Lawrence amid fog and rain. It was succeeded by a twenty-four hours' gale, rather severe for the season, which tested the excellent qualities of the *Nautilus* as a sea boat. This being our first storm at sea was enjoyed more keenly than similar gales in after years. The sea swept our deck, but only a few drops entered the cabin. The experience was novel and interesting, fortunately we were not sea sick; the long waves sloped up like far-reaching hills; sea birds rode on their crests, and the wind, like a swarm of furies, tore through our rigging. There were but occasional glimpses from the companion way of our dark, close cabin, redolent with the stench of the bilge water. The storm abated after sunset, and the morning of the 6th found us only fifty miles from Caribou island. Toward noon the first iceberg was seen; others came into view, some stranded, others floating on the sea.

The evening was a glorious one; after a gorgeous sunset, the twilight lasting until after ten o'clock, the moon rose upon berg and sea. We were in an arctic ocean; creatures born in the Greenland seas floated past our vessel, and while becalmed at night we fish up from a depth of sixty or seventy fathoms a basket starfish (*Astrophyton agassizii*) large enough to cover the bottom of a pail.

The impressions made on our minds the next day as we approached the coast and passed in shore, winding through the labyrinth of islands fringing the main land, are ineffaceable. That and other days in Southern Labrador are stamped indelibly on our mind. It was passing from the temperate zone into the life and nature of the arctic regions. There is a strange commingling of life-forms in the Straits of Belle Isle. The flora and fauna of the boreal regions struggling, as it were, to displace the arctic forms established on these shores since the ice period, when Labrador was mantled in perennial snow and ice, when the great auk, the walrus and the narwhal abounded in the waters of the Gulf of St. Lawrence, and the Greenland flora, represented by

the *Arenaria grœnlandica*, the dwarf cranberry, and the curlew berry or black Empetrum, nestled among the snow and ice of the glacier-ridden hills.

We landed on the morning of July 7th, and I was astonished at the richness of the arctic flora which carpeted the more level portions of the island. Groves of dwarfed alders, over which one could look while sitting down, crowded the sides of the valleys, watered by rills of pure ice-cold water. The groves of spruce and hackmatack were of the same lilliputian height. In the glades of these dwarfed forests, and scattered over the moss-covered rocks and bogs were *Cornus canadensis*, two varieties in flower; *Kalmia glauca* was in profusion, as attractive a flower as any; the curlew berry (*Empetrum nigrum*), the dwarf cranberry, with other flowers and grasses characteristic of the arctic and Alpine regions. Particularly noticeable were the clumps of dwarf willow from six inches to a foot in height, now in flower and visited by the arctic humble bee and other wild bees. Other insects of subarctic and arctic types were numerous, among them a geometrid moth (*Rheumaptera hastata*), which extends from the Alps and snow fields of Lapland around through Greenland and Labrador to the mountain regions of Maine, New Hampshire and Northern New York. The flies, beetles and other forms had an arctic aspect, showing that on the shores of the Straits of Belle Isle the insect fauna is largely tinged with circumpolar forms.

On the 7th of July our party of seven men landed, lodged in a Sibley tent, and the *Nautilus* left us for the Greenland seas with the majority of our party. Our tent, provisions and baggage becoming soaked with the rain and dampness; two days after, we moved over to Caribou island and built a house of Canada clapboards, kindly loaned for the purpose by the Rev. C. C. Carpenter, missionary to Southern Labrador, for whom a large frame house, sheltering under its roof a chapel, study and living rooms was building.

A Canadian clapboard is twelve inches long and six inches wide; with these and a few joists two of the party built a house twelve feet square, which sheltered us from the sun and the black flies, and only leaked when it stormed, which happened regularly twice a week, usually Wednesdays and Sundays. Six berths were put up on the north side (the seventh man was accommodated in the mission house); a wide board placed on two flour barrels at

the west end served as a dining and study table, and in the south-east corner a little stove, not over fifteen inches square, with a funnel whose elbow, projecting out-of-doors, had to be turned with every change of wind, was the *focus*, the modernized hearth-stone, over which hung our Lares and Penates, sundry hams and pieces of dried beef, *pièces-de-resistance* of our meals, often alleviated by game and fish, clams and scollops or pussels (*Pecten magellanicus*), with oases of seal and whale flesh. How we college boys cooked and ate, rambled and slept in those seven weeks of sub-arctic life is a subject of pleasant memory. They were days of rare pleasure, of continuous health, and formed an experience whose value lasted through our future lives. We made hunting, ornithological, entomological, botanical and dredging expeditions in all directions, by sea and land; the geology, and the flora and fauna were explored with zeal, and resulted in the discovery of many new forms and the detection of Alpine and arctic European species before unknown to this continent. We investigated the Quaternary formation, ice marks, drift and fossil shells; procured fossils of the Cambrian red sandstone beds, chiefly a sponge (a new species of Archæocyathus), which were scattered along the shore, probably derived from the red sandstone strata so well developed at Bradore, also visited by some of our party. The results were perhaps of some importance to science, and the lessons in natural science we learned of far greater moment to ourselves.

The coast of Labrador is fringed with islands, large and small, from the mouth of the St. Lawrence to Hudson's strait. A sail-boat can go with safety from one point to the other, and only occasionally will be exposed to the ocean swell. These islands are the exact counterpart of each other, differing mainly only in size and altitude. Caribou island was two or three miles in length, formed of Laurentian gneiss, which had been worn and molded by glaciers. Its scenic features recalled those of the more rugged portions of the coast of Maine, particularly in Penobscot bay and Mt. Desert. The higher portions of the island is of bare rounded rock, with deep valleys or fissures down which run little rills; these valleys are dense with ferns, shelter many insects, and where they widen out into the lower land support a growth of dwarf spruce, hackmatack and willow. In the more protected parts a few poplars and mountain ash rise to a height of from ten to fifteen feet. The Alpine vegetation is mostly confined to the ex-

posed boggy places or moors, in which are pools of water, supporting water boatmen, case worms, aquatic beetles and numerous water fleas, and an occasional hair worm or Gordius.

Along the lower portions by the shores are patches of salt marsh with shallow pools of water, which in the spring and autumn are undoubtedly frequented by ducks and geese, though only a few of the former were to be seen. Indeed, I was surprised to see so few sea-fowl. They were principally the parroquet, which abounded on the sea a mile or two away from shore. A favorite breeding place of this most interesting of arctic birds was in the soft red Cambrian sandstone of Bradore, an island lying fifteen miles easterly from Caribou island. With their powerful parrot-like beaks they excavate the crumbling rock, extending their galleries in to the distance of several feet. Three of our party made an expedition to this well-known breeding resort, and in thrusting their hands into the burrows received an occasional bite from the sharp strong bills of the birds, which was not soon forgotten. Ducks were occasionally seen, the eider duck and also the coot, as well as the loon, both the northern diver and the red-necked loon. Shore birds, particularly the ring-necked plover, and others of its family, abounded, while the most familiar bird was a white-headed sparrow which nested near our camp.

It was not yet the time for the curlews. About the middle of July the shelldrake and coot, which breed in the inland ponds, lead out their young and appear in great numbers. The old ones are wary and hard to shoot, but the young will then be in fine condition. At this time the "long-shore-men" abandon their diet of salt pork, bread and molasses, and feast on game, for then we were assured they have "great plenty fowl."

In August, also, one or two families of the red Indians or mountaineers of the interior come down to the mouth of the Esquimaux, or "Hawskimaw" river, as it is pronounced by the settlers, to hunt seal, especially the young, and ducks as well as curlew. These Indians are entirely governed in their wandering by the situation of the deer and other game. One may travel a hundred miles up the Esquimaux river without meeting them.

I saw but a single Esquimaux man at Caribou island. His low stature, his prominent, angular cheek bones, pentagonal face and straight black hair sufficiently characterized his stock. The only other native Esquimaux was the wife of an Englishman,

John Goddard, the "King of Labrador," who lived on a point of land three miles west of Caribou island. She was a famous hunter, would go out in a boat, shoot a seal and dress it, making boots and moccasins from the skin. Whether these Esquimaux had strayed down from the north or, as I suspect, were the remnants of their people who may have inhabited the entire coast from the Gulf of St. Lawrence to the arctic regions, deserves further investigation.

Few mammals were to be seen. The deer and caribou were confined to the mainland. On our island was a white fox, or rather a blue one, for his summer pelage was of a slate color. His burrow was situated in a hill side behind our house. He would prowl about our camp at night, and he might have known that it was unsafe to come within reach of our guns. His skin undoubtedly adorns the museum of the Lyceum of Natural History of Williams College.

A weazel also visited our camp. The otter frequents the brooks at the head of Salmon and Esquimaux rivers. In winter they rarely come outside, *i. e.*, to the coast.

It is well known that in Newfoundland the bears, especially those living near shore, will eat fish, their diet being mixed, and such bears are more savage than those in the interior which live chiefly on berries and ants. While on Caribou island a fisherman living a mile and a half from us had his sea-trout nets invaded by two old bears accompanied by a young one; at low water they would walk out to the nets, tearing them apart in order to eat the fish.

Speaking of trout, there are two kinds; one living in the brooks and lakes, the other the sea trout, a handsome fish about twelve inches in length, whose food we found consisted of a surface-swimming marine shrimp, the *Mysis oculata*, which lives in immense shoals. The sea trout is taken in nets, and so far as we experimented do not, in salt water, rise to the fly.

Although it was now the 15th of July the warmer summer weather had not yet come, we were told by the people on shore. There is, however, scarcely any spring in Labrador. The rivers open and the snow disappears by the 10th of June as a rule, and then the short summer is at once ushered in.

Potatoes and especially turnips are raised without much difficulty as far north as Caribou island. Rhubarb is said to do well farther up the coast towards the Mecatina islands. Among the

wild flowers blooming in the middle of July were the dandelion and *Potentilla anserina*. Another Potentilla was the *P. tridentata*, the mountain trident, with its three-toothed leaf and modest white flower. It was pleasant to see this flower, so familiar from my earliest childhood, as it flourishes on the plains of Brunswick, Me., and is common on Mt. Washington as well as on the mountains of Maine, and abounds on the bare spots about Moosehead lake, particularly at the foot of Mt. Kineo. The wild currant, strawberry and raspberry were in flower; the strawberry plants were luxuriant, sometimes eight inches in height, but the raspberries were dwarfed, not exceeding the strawberry in height. Up the rivers the raspberries and blackberries are abundant, but the latter low and dwarfish.

The shad bush (*Amelanchier canadensis*) was now in flower, blossoming in Southern New England in April or early May, while *Rubus chamæmorus*, the cloud berry, so abundant in Greenland and Arctic America as well as on the fields of Norway and Sweden and the "tundras" of Siberia, was going out of flower. With it were associated the star-flower, *Trientalis americana*, a few *Clintonia borealis*, *Smilacina bifoliata* and probably *S. stellata*, *Streptopus amplexifolia;* one or two species of Andromeda; an Iris, species of Vaccinium, the *Arctostaphylus uva-ursi* or bear berry; the shore pea, a honeysuckle (*Lonicera cærulea*), a Viburnum, and also the buckbean (*Menyanthes trifoliata*).

Among the flowers fluttered the white butterfly (*Pieris frigida*), a *Colias labradorensis*, *Argynnis triclaris* and some geometrid moths, while a few owlet moths flew out of the grass at the late twilight, which now lasted until near eleven o'clock at night, when fine print could be read.

We were told that the average temperature in June here is 48°, that of July 56°. In the warmer days of summer the thermometer rises from 64° to 68°, rarely to 70°. July 17th was one of the warmest and most pleasant days of the month; the temperature was 60° F. The 21st, however, was much warmer, the thermometer being 72° F.

July 18th was the day of the eclipse; the sun was obscured in theforenoon; the light of day was much modified, though not approaching twilight. The steamer which we saw on the day of the storm in the Gulf of St. Lawrence was without doubt that which bore the Coast Survey eclipse party to Cape Chidleigh, where the eclipse was total.

(*To be continued.*)

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The appropriation of money for scientific purposes by the Congress of the United States is a just source of national pride, as it is a means of national development and prosperity. The scientific men who have the disbursement of this money hold a trust for science, and their use of it is watched by the scientific men of all countries with interest. The expenditures have been, as it appears to us, generally well directed. One of our national establishments, however, seems to us to be in danger of absolute perversion from scientific uses and purposes, though, perhaps, intelligent attention directed to the situation may be the means of arresting such a misfortune. We refer to the National Museum at Washington. By its present organization it contemplates an exhibition of the products of the United States, both raw and manufactured. At the same time it does not embrace the agencies necessary for the prosecution of scientific research, either by making collections or supporting investigators. These latter objects are within the plan which the director, Professor Baird, hopes to see realized in the future, and it is earnestly to be desired that he may be able to accomplish so important a project. We must confess, however, to a sense of disappointment in learning that this was not the original basis on which the institution was created. It might, indeed, amount to this practically, were it not that manufactured products are included in the objects to be displayed in its halls; but the introduction of this item so overbalances the scales as to leave the future of scientific collections precarious, to say the least of it. We do not see how it is possible to avoid the crowding of the building with a kind of material which has no place in a scientific museum, and which can easily occupy all the space and consume all the money which Congress can grant it. The paternity of the project for a national museum was altogether scientific, and unless this object continues predominant, it is likely to divert the lives of a certain number of scientific men from their true channels, unless they abandon it altogether. For aught that we know, the situation may be past remedy, and the scientific element may already read the "handwriting on the wall." But we hope not. The most effective remedy would be to limit the exhibition of

manufactured products of the world to those which preceded the iron age of human industry. By cutting off everything that belongs to the industrial history of the iron age, pure science will save a great amount of money and a great deal of invaluable space.—*C.*

—— The year 1884 will be notable from the important discoveries in vertebrate biology and invertebrate palæontology. It had been suspected and even stated that two mammals, the duckbill and Echidna, laid eggs; but for the first time, late in the last year, was full and convincing proof afforded by two independent observers of the fact that both of these monotremes lay large eggs, with a soft parchment-like shell, which are placed in the mammary pouch, where they incubate until the young are hatched in a partially developed state.

Late in the year also came the announcement that Dr. Lindström had discovered a fossil scorpion in the upper Silurian (Ludlow) of the island of Gotland. The presence of the stigmata, proves that it breathed air directly and was a true land animal. The publication of this important news brought to light the fact that a fossil scorpion of the same genus had previously been obtained by Dr. Hunter from the upper Ludlow beds of Lanarkshire, Scotland. This two-fold discovery carries the existence of Arachnids from the Carboniferous to the upper Silurian horizon.

Still nearer the close of the year, at the last meeting in 1884 of the French Academy, M. Charles Brongniart announced the discovery in the middle Silurian of Calvados of an insect's wing referred to a cockroach. This transfers the first appearance of insect life from the upper Devonian to the middle Silurian.

On the other hand the discovery of trilobites in the Australian Cretaceous beds was announced last year in the *Geological Magazine*; so that this type of Arthropod life is carried up from the Carboniferous to the chalk period. It will be remembered that fossil vertebrates in beds near the base of the upper Silurian of this country were reported in this magazine during last autumn by Prof. E. W. Claypole. Thus the geological record is in a single year profoundly changed, and no one can foretell what discoveries may be made in the immediate future.

——The Geological Survey of Canada is undergoing one of those periodical attacks which politicians of the less educated type make upon all government institutions which they do not understand or appreciate. As usual, they do not perceive the necessity of understanding the principles of the geological structure of the country before satisfactory "practical" results can be obtained; but are crying for less theoretical and more "practical" geology. If they will make large appropriations to the survey

under Dr. Selwyn, they will in time get all the practical ends they are after; but they must let their able chief develop the subject in the only practicable way known to science, and which he is abundantly able to accomplish.

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RECENT LITERATURE.

De Nadaillac's Prehistoric America.[1]—In the present state of American archæology a general work on prehistoric America would be perhaps regarded as premature, or at least as a temporary makeshift. The French author, however, has had the courage to venture on the attempt to depict the pre-Columbian history of both Americas, covering the whole field of American anthropology. His work appeared in 1882. The present work is based on a translation of De Nadaillac's work. The original contained a good many unreliable conclusions, mixed with valuable or well ascertained facts, there being on the whole little discrimination whatever in the material used. In its present shape, however, having passed through the editorial hands of Mr. W. H. Dall, who has added some new material, we do not see but that it forms an excellent and, in the main, reliable account of American primitive times. There is a popular demand for such a work; its style is light and clear, perhaps not always so sober and circumstantial as we could wish, but on the whole the book in its American dress is timely. The chapter on the origin of man in America is almost wholly Mr. Dall's, who has only retained some references to Central American and Peruvian myths from the original. As it stands, therefore, the book may be considered as a fairly good résumé of the better known facts of American archæology from a more or less European standpoint. The chapters are headed as follows: man and the mastodon; the kitchen-middens and the caves; the mound-builders; pottery, weapons and ornaments of the mound-builders; the cliff-dwellers and the inhabitants of the pueblos; the people of Central America; Peru; the men of America, and the origin of man in America.

The views concerning the Toltecs and their successors, the Aztecs, and their monuments are moderate. Montezuma's so-called "empire" was apparently little more than a confederation of tribes. Their buildings are but a few centuries old; their civilization of spontaneous growth, and very recent compared with those of the old world. As to the connection between the Central American nations and the mound-builders, this book is conservative, not conceding any such intimate relation. So far good,

[1] *Prehistoric America.* By the Marquis de Nadaillac. Translated by N. D'Anvers. Edited by W. H. Dall. With 219 illustrations. New York and London, S. P. Putnam's Sons, 1884. 8vo, pp. 566. $4.

but when the French author says that primeval man in America had to contend with elephants and edentate animals, and that the period in which he lived "was marked by floods, of which man still retains traditions;" when he proceeds to cover a large area of California with glaciers, and adopts without reservation Agassiz's view that Brazil was once covered with glaciers, we wish for a soberer, more critical narrator of events. Again the Trenton unpolished stone implements occur in the higher river terraces, which were formed long after the ice had melted and disappeared; they do not occur in true glacial deposits. Yet Nadaillac thus declaims in reference to the Trenton finds: "Man

Truncated Mound at Marietta, Ohio.

lived through these convulsions; he survived the rigors of the cold; he survived the floods, as the recent discoveries of Dr. Abbott in the glacial deposits of the Delaware near Trenton, N. J., seem to prove beyond a doubt."

Is our author not mistaken in saying that the Calaveras skull "resembles the Eskimo type;" was not Wyman's opinion that it resembled that of a California Indian the more natural and correct one?

Regarding the mound-builders, the sensible view is expressed that they were no more nor less than the immediate predecessors in blood and culture of the Indians described by De Soto's chronicler and other early explorers, the Indians who inhabited

the region of the mounds at the time of their discovery by civilized men. As in the far north, the Aleuts up to the time of their discovery were, by the testimony of the shell-heaps, as well as their language, the direct successors of the early Eskimos—so in the fertile basin of the Mississippi, the Indians were the builders or the successors of the builders of the singular and varied structures just described. The pottery of the mound-builders is quite fully described and illustrated, and it is remarked that if the American pottery be "compared with that from the middens of the lake-dwellers of Switzerland, who are supposed to have reached a similar stage of civilization, one is astonished at the inferiority of the latter."

The views respecting the period in which the mound-builders lived, and their relations to the Indian tribes at the time of the conquest are moderate and sensible. The mound-builders were

Group of Sepulchral Mounds.

a numerous, tolerably homogeneous people, with nearly similar funeral rites and much the same arts; they were sedentary, "for nomads could not have erected such temples or constructed such intrenchments;" they were also agricultural as well as fond of trading. "All testify to the fact that the men, whose traces we are seeking, had long since risen from the barbarism of savagery, and that they had attained to a state of comparative culture."

The Indians of Florida and Alabama, whose mound-building habits were described by Garcilasso de la Vega; those of Georgia, Tennessee, Mississippi and Arkansas, who disputed the advance of De Soto in their fortified walled towns; the Indians of Virginia and the Carolinas are probably the lineal descendants of the mound-builders, and thus the air of mystery thrown over the subject by popular writers and untrained archæologists has been of late years dispelled. As for the mounds themselves "a

lapse of thirty centuries or of five would account equally well for the development of the civilization they represent." Short's opinion is quoted with approbation that "one or at the most two thousand years only can have elapsed since the mound-builders were compelled to abandon the valleys of the Ohio and its tributaries, and but seven or eight hundred since they retired from the shores of the Gulf of Mexico. Lastly, the early explorers found mounds occupied and even being constructed within the last few hundred years."

Erratic blocks covered with figures, Arizona.

The accounts of the ruins and people of Central America and Peru are useful and timely, as is the chapter on the physical structure of the early man of America; the latter is often critical and with full references to the most recent authorities.

Our impression formed from reading and observation is that the view that there is an unity of race in North and South America, that the continent was peopled from Asia by way of Bering straits, and that the race shared the continent with only one

other race, the Eskimo, is most in accord with facts. We do not see that there are grounds for considering that any race on American soil was any lower in body, mind or culture than the existing Indians and Eskimo. Archæology has failed to indicate the existence of a race intermediate between the apes and man. Wherever traces of human beings occur, they indicate that man has everywhere appeared as man. Traces of a "missing link" may yet be discovered. Any day may bring forth the proof, but sound reasoning from observed facts does not yet show that fossil man in Europe or America was any lower, if so low, as the existing Australians. To say with Nadaillac that primitive man once existed in America "in a state of the lowest barbarism, and but little elevated above the brutes, at an exceedingly distant epoch," is to state what has not been proved. The high state of development and culture attained by the majority of the Indians of North America at the time of the discovery is to us a continual source of surprise; the high degree of culture of the Eskimo, perhaps the most primitive race existing, is, in some respects, almost startling. We are far away from any traces of the missing link. The so-called "Tertiary" man, most often Quaternary, in regions where glaciers never existed, seems almost beside the question in the present state of our knowledge.

The volume is elegantly printed, fully, almost lavishly illustrated, and on the whole is the most comprehensive and readable view of this entrancing topic one can now obtain.

INGERSOLL'S COUNTRY COUSINS.[1]—Country Cousins is the title of a little book of breezy natural history stories, most of which have previously appeared in the *Century*, *St. Nicholas*, the *Field* (London) or other periodicals. Such books as these, full of true inner life of animals, brimming over with psychology without burdening their pages with the long word, do more to encourage a love of nature among the young, and to make biological students, than all the wearisome technicalities in which anatomists and zoölogists often indulge when writing for a public that needs plain talk. The squirrel-mother's care for the orphaned young is made the vehicle of much deep teaching; the shrews are depicted in all their true shrewishness; the birds of the brookside are interviewed at home; nature is visited in her winter quarters; the workings of a seaside laboratory are exhibited, and so on. Mr. Ingersoll has common-sense ideas on the subject of snake "fascination," and gives good directions for the formation and keeping up of a naturalists' club. The hibernation of bats, bears, etc., the vitality of marine animals, rattlesnakes, the life of an oyster and of his enemy, the starfish, are among the subjects pleasantly treated of in this attractive volume.

[1] *Country Cousins.* Short Studies in the Natural History of the United States. By ERNEST INGERSOLL. New York, Harper Brothers. 1884.

THE GEOLOGY OF INDIANA.—The thirteenth annual report of the geology and natural history of this State, by John Collett, State geologist, fills a volume of 264 pages, with thirty-nine plates. The large folding geological map of the State has been prepared from the labors of Owen, Lawrence, Brown and Cox, as well as the present geologist and his assistants. The report of Mr. Leo Lesquereux is entitled, Principles of Palæozoic Botany, and is a most useful manual by the leading authority on this subject. It gives character and value to the report, and is fully illustrated. It will be easily understood by the lay reader. In the same useful direction is Dr. C. A. White's Fossils of the Indiana rocks, No. 3, which treats of the fossil animals of the coal measures of the State. Besides these chapters a due amount of space is devoted to the economic geology of the State by the State geologist and his assistants.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Asiatic Notes.*—The peninsula of Kamtchatka is by the Russische Revue said to contain but 6500 people. There is no agriculture, and for food they rely mainly on the fish, chiefly salmon which throng the rivers in summer, and are dried and stored for the winter. On account of the scarcity and dearness of salt the fish often decompose, and the people suffer great privation. For clothes, utensils, tea, tobacco, they have to look abroad, and their imports, paid for in sable skins, are almost wholly from California. A chain of volcanic mountains, reaching 5000 feet in height, runs down the center of the peninsula, and through this the large navigable river Kamtchatka makes its way to the Pacific. ——M. Leon de Rosny, the Japanese scholar, insists that the Aino is one of the two chief factors in the present Japanese race. He believes the Aino element to be a large one, and bases his arguments on an examination of the cosmogony, which contains two separate and distinctly marked mythologies, one of which is transparently aboriginal. Thus the Japanese of to-day is, in his opinion, a mixture of the conquering yellow and the conquered white races.——The celebrated French traveler, Charles Huber, who has, since 1879, been engaged in the exploration of the archæological remains of Central Arabia, was killed on July 30th, at Tafua by Bedouins of the tribe of Harb, while on his way from Hail to the Persian gulf.——Steers and Calmeyer islands, the product of the Krakatoa eruption, have again sunk, as has also an island a mile east of Verlaten island.——In 1868 a Russian surveying officer accidently discovered in the Altai mountains the settlements of some Russian sectaries who had migrated thither during the last century. Recently the governor-general of Irkutsk, in a progress through his province, came upon a town called Ilim, with four churches and 150 houses. The town was governed by a *vetche* or public assembly, convoked by the ringing of a great bell, as at Novgorod the Great in its republican days. None of the inhabitants could read or write. The traveler Adrianen found settlements of sectaries, founded in 1800, at Tobut on Lake Koko-nor. These colonists had acquired savage and predatory habits.——M. A. Marche has explored the Calamienes archipelago south-west of Mindoro and north of Paluan. The three chief islands are Busuanga, Calamienes or Culion, and Linacapan. The natives of Culion are Tagbannas, an ancient people found also in Paluan, and probably spread formerly over a wider area. Some few are Christianized, but most are independent, and are fetich-worshipers. In the island of Dibatac, hills surround a horseshoe-shaped plain with a depression in the cen-

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

ter—perhaps volcanic.——A new map of Saghalin, prepared by M. Nikitine, shows that island to be considerably larger than was supposed. While M. Reclus gave the area as 63,600 square kilometers, M. Venukoff calculates that 73,529 is a nearer approximation. ——It has been hitherto thought that the Gilbert islands were fast wearing away by the action of the sea during western gales. The belief was based upon the absence of the lee or western reef on some islands, and the anchorage afforded on the lee side of others, but a trader who has resided four years on Peru or Francis island states that when he came he could pass through the reef passage with a loaded boat at all states of the tide, whereas now the passage is dry at low water. From this and other indications it is believed that the island has risen two feet in the four years.

AFRICA.—*Results of the Journey of Mr. Jos. Thomson.*—West of Mombasa, on passing the Rabai hills, lies the undulating country of Duruma, densely covered with bush and tangle and thorny scrab. The miserable natives of this district are in perpetual dread of famine and of the spears of the Masai. At three days march from Mombasa an uninhabited country is reached, and by the fifth day a glaring sterile red sand marks the change from sandstone to schists and gneiss, thorns and gnarled trees replace the bush, and the land is flat. This waterless uninhabited wilderness extends from Usambara and Paré in the south to Ukambni and the Galla country in the north, and from Duruma in the east, to the volcano of Kilimanjaro westward; broken only by the mountains of Teita, arising like precipitous islands in a muddy sea to from three to seven thousand feet. On the western side of this desert, and somewhat eastward of the south side of Kilimanjaro, lies the district of Taveta, a bit of tropical forest on the banks of the snow-fed Lumi. The natives are a mixture of the Bantu tribe of Wa-Taveta with Masai who have been forced by the loss of their cattle to an agricultural life, and are a manly, pleasant, and honest, though immoral race. Kilimanjaro, the central mass of this region, has two summits, one the grand dome or crater of Kibo, towering above the forest-clad pediment of Chaga (where Mr. H. H. Johnstone is now residing with the chief Mandara) to a height above the sea about 18,880 feet; the other the pinnacle of Kimawenzi (16,250 feet) with its dark rocks and jagged outlines. The base of the mountain near Taveta is dotted with parasitic cones, and a few miles to the north of Taveta lies the small crater lake of Chala, in the center of a crater about two and a half miles across. The southern slopes of Kilimanjaro are (according to Mr. Jos. Thomson, from whose recital before the Royal Geographical Society these particulars are taken) carved into varied scenes of hill and dale by numerous streams, which rise high upon the flanks, and upon Mr. Thomson's map are shown as united into one river further south. The Lumi falls into Lake

Jipé, a small elongated lake south of Taveta, and this lake is shown as having an outlet into the system of streams which flows from the mountain slopes to the westward. On the eastern side of Kilimanjaro the sources of the Tzavo gush forth at the base, but on the northern side stretches the great plain of Ngiri, once, as is proved by the ponds and swamps yet remaining, the bottom of a lake. Ngiri is 3550 feet above the sea. Not a stream descends from the mountain on its northern side.

Lakes Naivaha and Baringo prove to be both of small size. The latter especially has shrunk, from the liberal dimensions accorded it upon the best maps published before Mr. Thomson's journey, into an island-dotted sheet about a quarter of a degree in length. Both lakes occupy portions of a longitudinal trough, akin to that in which the Dead and Red seas are lodged, and running north and south for an immence distance; flanked to the east by the Kaptè plateau, and westward by the escarpment of Mau. This depression was reached by Mr. Thomson from the south, after passing through Ngiri and through the Matumbato, a sterile but somewhat watered and inhabited broken country with red soil. South of Naivasha the trough is occupied by a desert, and the caravan ascended the Kaptè plateau for food and water, resting awhile at Ngongo-a-Bagas (6150 feet) near thè source of the river Alhi, which waters the country of Ukambani farther to the east. A little to the south of Lake Naivasha is the remarkable conical extinct volcano Donyo (mountain) Longonot. This rises 3000 feet above the plateau or 9000 above the sea, and the edge of the crater, which is about two miles across, is so sharp that a man can sit astride of it. Lake Naivasha is a comparatively shallow freshwater lake, about twelve miles long by nine wide, formed by the piling up of volcanic débris across the trough in which it stands. Cones and craters, the steaming mountain of Buru, faults producing angular outlines, and hot springs, attest recent volcanic activity. Further north, at Lake Baringo, the eastern side of the meridional depression is formed by the Lykipia mountains, which rise nearly 8000 feet abruptly above the lake. Opposite tower the Elgeyo precipices to a height of 7750 feet, a northern continuation of the Mau escarpment. The depression is here longitudinally divided by the Kamasia mountains. Lake Baringo lies west of these, while in the narrow valley between them and Elgeyo the Mbage or Weimei river runs toward the north through the Galla country to the salt lake Samburu.

Near Lake Naivasha Mr. Thomson, with a party of thirty men, left the main caravan, ascended the plateau to the east, here called Lykipia, and made his way to the foot of Mt. Kenia, hitherto unvisited by any European. The rivers of this region flow into the as yet unexplored Guaso Nyiro. On the way to Kenia a range of mountains, running north and south, and rising to nearly 14,000 feet was crossed. These were named the Aberdane moun-

tains. Kenia, like Kilimanjaro, is a volcanic cone. The base is nearly thirty miles across, and its sides slope upwards at a low angle, almost unbroken by ridge or glen, to a height of 15,000 feet. Above this rises a sugar-loaf peak, with glittering facets of snow on its upper 3000 feet, yet with sides so steep that the snow will not lie in many places. At this point the enmity of the Masai, coupled with the atrocious nature of the food, which as all the cattle were dying of some plague, consisted liberally of rotten meat, compelled a retreat in the direction of Lake Baringe.

Westward from the Elyeyo precipices extends the vast treeless plain of Guas-Ngishu, bounded northward by the great volcanic mountain of Masawa or Elgon—a counter part of Kenia without the upper peak. Farther northward lies the occasionally snow clad mountain Donyo Lekakisera. The country of Kavirondo lies to the west of the shelterless plateau, and surrounds the north-east part of Victoria Nyanza. It extends to within forty miles of the Nile, and does not reach more than thirty miles south of the equator. A considerable part of this tract lies where Victoria Nyanza is shown upon our maps. The Wa-Kavirondo are a pleasant people, dangerous only when excited or drunk, and though the similarity of houses, manners, mode of life, etc., suggest unity of race, are really, as their language indicates, formed of a mixture of Wa-swahili with Nile tribes, the latter predominating southward. Kwa-sundu is a large town, and food can here be obtained in marvelous abundance and cheapness. The Wa-kavrondo wear no clothes, unless a small bunch of cord, worn tail-fashion by the married women only, can be styled an article of clothing.

Mr. O'Neill's Explorations.—The journey recently undertaken by Mr. H. E. O'Neill to Lakes Shirwa and Amaramba has solved the problem of the sources of the Lujenda. That river does not rise in Lake Kilwa or Shirwa but flows from Lake Amaramba, which is connected by the river Msambiti with Lake Chireta. These small lakes lie north of Kilwa, which has not been known to connect with their drainage within the memory of man, although the slight difference in level between the Mikoko river (which flows into Lake Kilwa) and the Mtoradenga swamp is so light that such a connection may probably follow unusually heavy rains. Mr. O'Neill believes that the Rev. Mr. Johnson's statement that Lake Kilwa has its outlet in the Lujenda is due to a mistake, and that the spot visited by Mr. Johnson was really the northern end of Lake Amaramba. The description of the scenery given by Mr. Johnson tallies with that at Amaramba, and the natives, who told Mr. O'Neill that he was the first white man who had visited Kilwa, remembered the visit of an European to Amaramba. The water of Lake Kilwa is brackish, that of the more northern lakes sweet and drinkable.

On his return to the coast Mr. O'Neill took a more southerly

course, with the object to discover some practicable channel of communication with the natives of the large area of country lying between Lake Nyassa and the coast. A large portion of this country, marked upon the maps as Makua land, is really occupied by the Lomwe. The valley of the Likuga is very thickly peopled, as is indeed the entire country except near the coast where the long continued slave trade has caused depopulation. Mr. O'Neill believes the reverenced Namuli peak to be an extinct volcano, the upper cone of which has disappeared. The Lomwe of the Likugu are a strong tribe and have a bad character among the slave-dealing traders who are not allowed to pass through their country. Their houses are oblong, strong, and with doors and veranda high enough to be entered without stooping. The only rivers that extend a considerable distance inland between the Zambezi and Lujenda are the Miuli, Ligonya, Mlela and Likugu, but none of these furnish a waterway into the interior, which can, in Mr. O'Neill's opinion, be reached most conveniently from Lake Nyassa and the Shiré.

In a subsequent journey Mr. O'Neill has traced the course of the Ruo river, which has been brought forward as the natural and proper boundary of the Portuguese in this direction.

GEOLOGY AND PALÆONTOLOGY.

THE POSITION OF PTERICHTHYS IN THE SYSTEM.—It is probable that the most primitive type of vertebrate of which we have any knowledge in a fossil state is the genus Pterichthys, if vertebrate it can be called. No intelligent attempt has as yet been made to assign this animal to its exact position. The opportunity of examining specimens of the *P. canadensis* Whiteaves, having been afforded me by Dr. A. R. C. Selwyn, director of the Geological Survey of Canada, I give here the results of my examination. Numerous specimens in which the anterior portion of the animal is well preserved, display three important peculiarities. There is a single opening on the middle line above. There are no orbits. There is no lower jaw.[1] The single opening may well be compared with the so-called nasal pouch of the lampreys. The absence of orbits is comparable to the condition in Amphioxus. In the absence of a lower jaw it agrees with both the types mentioned.

I have also instituted comparisons with the Tunicate genus Chelyosoma, of which the Smithsonian Institution, through the recommendation of Dr. Dall, has liberally placed at my disposal a fine alcoholic specimen from Point Barrow, Alaska. The scutellation of the dorsum of this animal agrees in every detail with that of Pterichthys, excepting in some of the small segments

[1] A pair of small, delicate laminiform bones found beneath the anterior end of the carapace are of uncertain determination.

about the lateral anterior border, and in the intercalated small plates which surround the anus between the first and second dorsal scuta. The anterior orifice is surrounded by six scuta distinct from the marginals, as in Chelyosoma. But they are differently arranged in the Pterichthyidæ, one forming a median valve of the mouth or *notosome*, and one being embraced in a larger posterior one.

The following hypothesis may be framed to account for these resemblances, which will also probably give Pterichthys its true position. The larva of Chelyosoma may be reasonably supposed to be caudate and notochordal, as are other Tunicata. In this stage its resemblance to Pterichthys would be great, especially if it possesses lateral limb-like processes as in Appendicularia, placed further forwards than in that genus. Possibly also in this stage the belly will be found to be shielded like the back, which would be

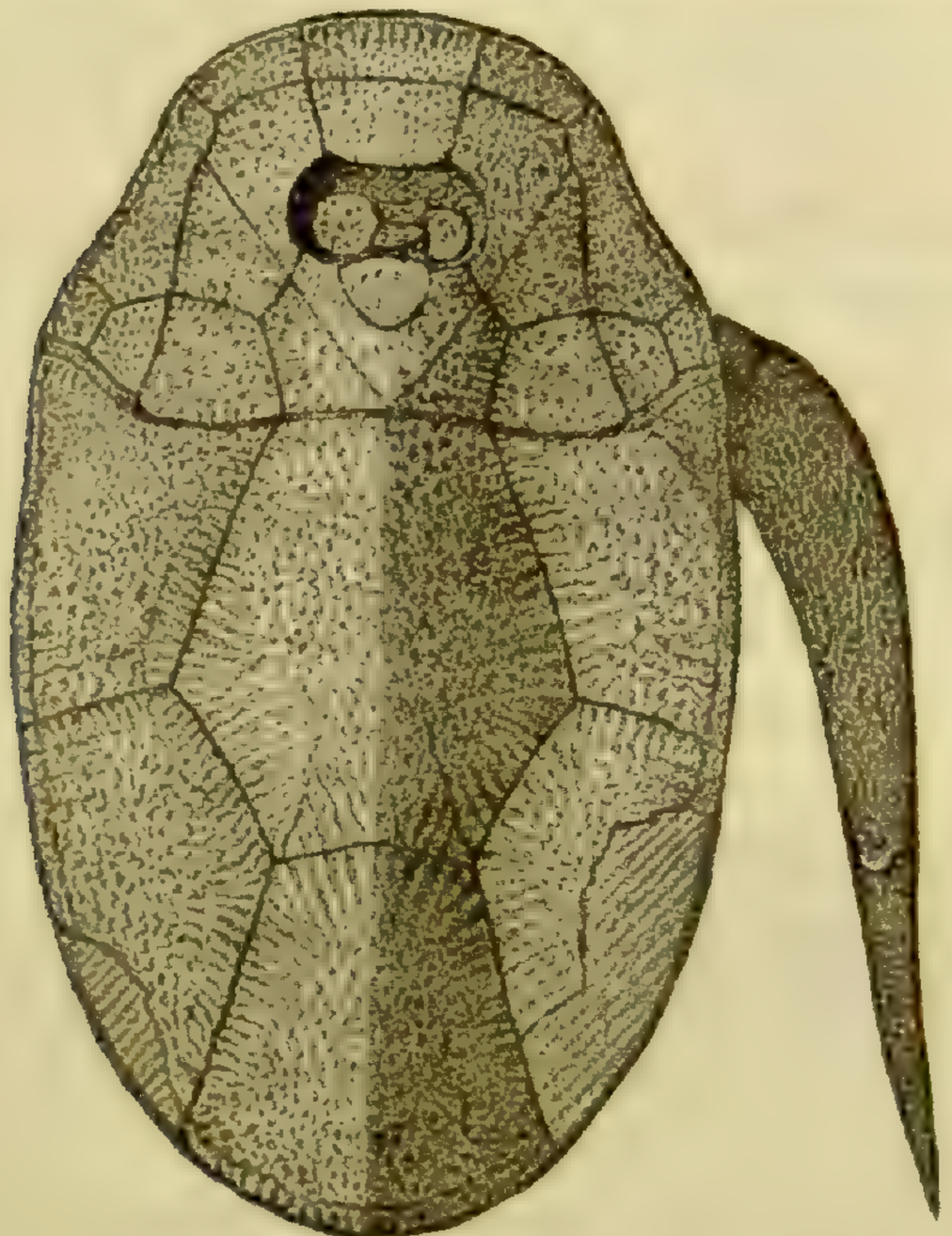

Fig. 1.

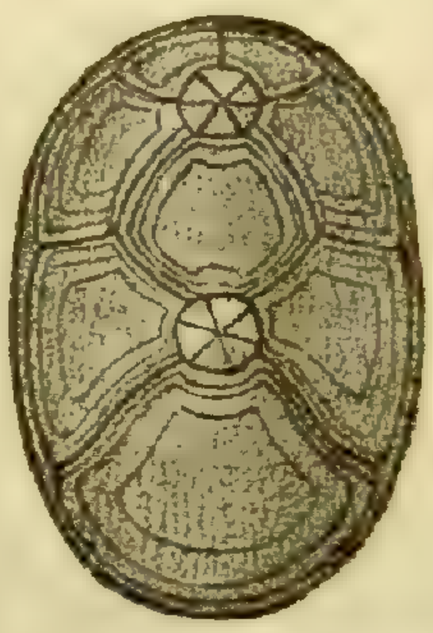

Fig. 2.

FIG. 1.—*Bothriolepis canadensis* Whiteaves, from above, half size of a small specimen. The valve of the dorsal mouth, or notosome, is broken. FIG. 2.—*Chelyosoma maclovianum* Brod. & Sow., $\frac{4}{3}$ natural size, from Point Barrow, Alaska.

a still further point of approximation to Pterichthys. From such a type I strongly suspect the latter genus to have descended. The principal change which it has undergone has been the substitution of the dorsal anus by the normal vertebrate position at the posterior extremity of the body. The tail has been retained in the European form.

If the above hypothesis be true, the single cephalic opening represents the tunicate mouth, and is the anterior extremity of the alimentary canal. This corroborates the theory that the "nasal pouch" and epiphysis or pineal gland of other vertebrates, represent the primitive mouth and œsophagus, as held by Geof-

froy St. Hilaire, Owen and Lankester. On the other hand, in view of the absence of orbits, the theory of Ahlborn and Rabl Ruckard that these parts represent a primitive organ of sense or sight, must be taken into account. The close approximation of the orbits in some of the Cephalaspididæ might add plausibility to this opinion. This would require us to believe that Pterichthys is a monoculus, as it has no interorbital septum, and that the eyes of other Vertebrata have been derived from this single one by division and gradual separation of the halves. Such a view is not confirmed by the embryology of the eye, nor does it necessarily follow from the facts of palæontology. The resemblance between the median orifice of Pterichthys and the orbits of the Cephalaspididæ is probably delusive, and the latter family has probably very remote affinity to the Pterichthyidæ.

In view of the position of the mouth, it seems to me that this family should be removed from the Craniata to the Urochorda. It is true that the evidence that this orifice is a functional mouth is not entirely conclusive, as the transfer of the extremity of the œsophagus to the opening at the anterior extremity of the carapace may have taken place, as in the case of the anus. But there seems to be little doubt of the homology of the dorsal orifice with the mouth of Chelyosoma, and the structural resemblance to it decides in favor of the Urochorda rather than the Marsipobranchii. Among Urochorda it differs from the Tunicata in the position of the anus, which is the normal vertebrate, and not the dorsal orifice of the former division. It will, therefore, form a second order of the class Urochorda, which I propose to call Antiarcha.

It may be more than a coincidence that while the Chelyosoma is an arctic type, the Pterichthyidæ are so far only known from northern regions, Russia, Scotland, and the province of Quebec, Canada.

After an examination of at least fifty specimens of the *Pterichthys canadensis* neither Mr. Whiteaves nor myself have been able to discover any trace of a tail or of its scales. The possibility of this species having absorbed its tail like the Tunicates is increased by the fact that the posterior border of the carapace is not openly concave as in the *P. milleri*, but is regularly rounded as in Chelyosoma. I suspect that the *P. canadensis* belongs to a genus distinct from the *P. milleri*, which may, for the present, bear Eichwald's name Bothriolepis. The relations of Coccosteus to this order are not close, if the restorations given are correct, although it retains the same type of ventral plates.—*E. D. Cope.*

Types of Carboniferous Xiphosura new to North America. —We have received from R. D. Lacoe, Esq., of Pittston, Pa., for study and identification, a valuable collection of Carboniferous Xiphosura, mostly from the Mazon Creek beds at Morris, Ill. Besides a series of *Euproops danæ*, there is an undescribed spe-

cies of Belinurus, and of Cyclus, two genera new to this continent; also a new type probably referable to the Merostomata, which may be called Dipeltis. From the Carboniferous beds of Pennsylvania there is a new species of Euproops. It need scarcely be added that the discovery of these forms, new to our American Carboniferous fauna, is a matter of considerable interest.

Moreover, the specimen of Cyclus shows traces of four or five pairs of limbs, apparently of the same nature as those of the larval Limuli, proving that Cyclus is in reality, so to speak, a tailless Limuloid. We are able also to report the existence of cephalic appendages in Euproops, as seen in a well-preserved *Euproops danæ*, received from Mr. J. C. Carr, of Morris, Illinois.

We will add brief descriptions of the new forms, reserving figures, fuller descriptions, and measurements for a future occasion.

Belinurus lacoei, n. sp.—Cephalic shield with a long lateral acute spine on each side extending to a point either opposite or a little behind the middle of the urosome (abdomen), or nearly to the base of the caudal spine. The urosome much more rounded and shorter than in the European *B. reginæ*, being about twice as broad as long. The caudal spine is long and slender, nearly one-half longer than the body, *i. e.*, longer than the whole body by the length of the head. Length of body including caudal spine $33^{mm.}$ In nodules at Mazon creek, Morris, Ill. Collection of R. D. Lacoe.

Euproops longispina, n. sp.—The median lobe of the cephalic shield is larger in proportion to the entire shield than in *E. danæ*, and the eyes are much nearer the lateral margin. Ocelli distinctly marked (not before observed in the Carboniferous Limuloids), situated on the median ridge of the median lobe of the head, a little behind its anterior termination, and a little in front of a line drawn through the compound eyes. The lateral spines are much longer than in any specimen of *E. danæ* from the Morris, Ill., beds, being long and slender, extending nearly or quite to the base of the caudal spine. No. 214^{a} Oakwood colliery, Wilkes-Barre, Pa. Length of body without the caudal spine $30^{mm,}$ breadth $37^{mm;}$ a smaller specimen (Nos. $215^{a,}$ 215^{b}), from Butler mine, Pittston, Pa. Collection of R. D. Lacoe.

Regarding the position of the Illinois and Pennsylvania beds containing these fossils, Mr. Lacoe writes me: "The horizon of the Pennsylvania specimens of Euproops is much higher than that of Mazon creek. The latter is at the very base of the productive coal measures in shale over the bottom seam of coal. The specimen from the Butler mine, Pittston, is from shale over coal 'E' (Mammoth vein), at the top of the lower productive coal measures, about 300 feet above, and that from the Oakwood colliery is either from the same horizon or the bottom of the lower barren measure next overlying it. The shaft from which it was taken, penetrating both the exact position of the rock con-

taining it could not be ascertained when we discovered it in the 'dump' or rock-pile."

Cyclus americanus, n. sp.—In a nodule from Mazon creek, Illinois, received from Mr. Lacoe, I recognize a species of this rather obscure genus which has not before occurred in North America, but is represented in Europe by nine species.

In form *C. americana* is perfectly orbicular, the length being exactly equaled by the breadth. It is regularly disk-shaped, flattened hemispherical, with the edge of the body broadly and regularly emarginate, the margin being thin and flat, and apparently a little wider on the sides than on the anterior or posterior end. Length $14^{mm.}$ breadth $14^{mm.}$

None of the species yet described have had limbs, and nothing was known, so far as we are aware, of the nature of the limbs. Fortunately there are in Mr. Lacoe's specimen traces of four, and perhaps five pairs of limbs, showing that Cyclus had short, stout cephalic appendages, which, when extended, reached near the edge of the cephalic shield. They evidently were like the legs of the larval Limulus and the Belinurinæ, though the extremities are not preserved sufficiently well for us to ascertain whether they ended in forceps, as in Limulus, or not, though they probably did.

Another fortunate discovery is that of the nature of the cephalic appendages of Euproops. In a nodule received from Mr. J. C. Carr, all the ambulatory limbs, except the first pair, are distinctly preserved, with faint traces of the shorter first pair which have the position and relative size of those of the larval Limulus just before hatching. The cephalic limbs of the second, third, fourth and fifth pairs are of nearly the same size, the fifth pair slightly longer, as the tips reach near the edge of the cephalic shield. Each pair is chelate, the forceps being well developed, and distinctly seen in the third and fourth pair. The sixth pair differ from the others as in Limulus, and almost exactly correspond to the shape of the larval Limulus figured in our first memoir on Limulus (our Figs. 23^{d}, 24^{a} and 25^{a}), though perhaps a little shorter. Thus Limulus passes through a trilobitic, and afterwards a Belinurus stage. The species of Cyclus may be referred to a distinct family group for which we propose the name *Cyclidæ*.

Dipeltis diplodiscus, gen. et sp. nov.—This name is proposed for a singular form which is not satisfactorily preserved, so that its exact relations are not readily determinable, though it will be recognizable as a Cyclus-like form. The body is suborbicular, flattened, disk-like, sloping regularly and gradually from the median area to the edge; it is divided into two portions; the larger one to be regarded as anterior or the cephalic shield, and the other as posterior, constituting the abdomen (urosome). The edge of the body is very slightly emarginate, not broadly so as in Cyclus; nor is the body distinctly trilobate as in the Limulidæ, though

unfortunately the median area of the cephalic shield is wanting. The integument is rather thin, showing no traces of segments; its surface may have had a few scattered small tubercles, at least there are slight indications of them. The surface is smooth and shining.

The cephalic shield is nearly twice as broad as long; the posterior lateral angle is well-rounded, with no sign of a lateral spine; in front the edge was probably obtusely rounded; the surface is slightly convex, the disk being low and flat; the hind edge of the shield is moderately concave, the limits between it and the urosome being clearly indicated by a slight, but distinct, regular curvilinear suture.

The urosome is about three-fourths as long as, but equal in width to the cephalic shield. The front edge is somewhat arcuate, so that the projecting anterior-lateral angle is directed a little forward, and is quite free from the lateral angle of the cephalic shield, which turns away anteriorly from it, leaving a triangular space between the sides of the two regions. Posterior edge of the urosome regularly rounded, and with slight margin. No traces of a caudal lobe or spine. Total length 20^{mm}; total breadth 20^{mm}; length of cephalic shield 11^{mm}; breadth 20^{mm}; length of urosome, 9^{mm}; breadth, 19.5^{mm}. Collection of R. D. Lacoe, 2017 [a, b, c,] in a nodule from Mazon creek, Morris, Illinois.

This remarkable animal was disk-like in shape, composed of two regions, the head and abdomen or urosome, which are more distinctly separate than in the Cyclidæ; yet there are no positive characters to separate it from this group, to which we would, for the present at least, refer it, as it is orbicular, tailless, and consists of a broad, large cephalic shield, with a shorter urosome. —*A. S. Packard.*

Geological Notes.—*General.*—E. Cortese (*Bull. Comit. geol. d'Ital., 1882*), gives the result of his studies of the geology of N. E. Sicily. The crystalline mica schists and gneiss form mountains continuing those of Calabria; above them lie blackish-gray, pearly, lustrous, folded phyllites, probably Silurian, associated with the granite of Savoca, the felsite of Castelmola, and the tourmaliniferous pegmatite of Cape Calava, and with dolomitic and crystalline limestone. The crystalline mass of Cape Calava is probably Devonian. In the neighborhood of Ali on the east coast the phyllite is followed by quartzite, associated with slates, sandstone and conglomerates. Above these lies the gray limestone, of which Cape Ali is formed, and in other places yellow and violet shales, quartzite, and hornstone are alternated, and these are followed by a reddish quartzite, variously colored shales and gypsum. These may be Permian, they are not in contact with the succeeding trias. The mesozoic beds are not extensive, but are variously developed. The lower trias, muschelkalk and

upper trias exist, the latter commencing with well-developed beds of red and white dolomite. At Cape Taormina Rhætic beds are seen. The various stages of the Lias can be identified by their fossils, and the series is completed by the chalk, which appears only at one spot (Coll. Re.)

Silurian.—At a recent meeting of the Paris Academy of Sciences, M. Daubrée called attention to the discovery, by M. Buneau, in coal belonging to the Lower Carboniferous, of the remains of a species of Equisetum, a genus not previously known to occur below the middle coal measures. The remains of the stems occurred with various Diplothemema and Calymmatotheca, which proved the stage to be the upper grauwacke. The species has been named *E. antiquum.*——M. A. Milne-Edwards announced the discovery in the Silurian of Scotland, of a new scorpion absolutely identical with that which had previously been found by M. Lindstrom in the upper Silurian of the island of Gothland. The only difference is one of sex, the one being male, and the other female.——M. Brongniart recently called the attention of the Paris Academy of Sciences to a fragment of rock belonging to the middle Silurian, and containing the impression of an insect's wing, that of a cockroach, differing from all other blattidian wings, recent or fossil, in the length of the anal nerve, and the width of the axillary field. M. Brongniart called this ancestor of the cockroaches *Palæoblattina penvillei*, and stated that it was more ancient than the scorpion found by M. Lindstrom, since it belonged to the middle instead of the upper Silurian. The insect fauna of Carboniferous age is already known to be large; the beds of Commentry alone have furnished thirteen hundred.

Carboniferous.—M. Ed. Bureau states that the basin of the Lower Loire is probably the only part of France which presents at once the three stages of the Carboniferous formation. The great Silurian depression between Brittany and La Vendee is formed into parallel furrows, of which the central contains coal of the age of the second half of the Lower Carboniferous stage; while the northern was filled with carboniferous deposits at the middle of the middle Carboniferous; the southern at the end of the middle Carboniferous, and finally a bed was deposited above the lowest one toward the middle of the upper Carboniferous stage.

Jurassic.—M. Cotteau has presented to the Paris Academy of Sciences, a new work on Jurassic Echini. This includes the description of the species of Polycyphus, remarkable for their small dimensions and their numerous tubercles; also of Phymechinus, as yet only found in Jurassic strata, and near Stomechinus, which it resembles in its imperforate and non-crenellated tubercles, but from which it is well distinguished by the bigeminal arrangement of its pores.——C. F. Parona (Mem. Accad. dei Lincei, 1883) gives a list of the mollusks and brachiopods of the Lias of the central Apennines.

Tertiary.—M. V. Lemoine compares Pleuraspidotherium, a mammal from the Cornaysien fauna of Reims, on the one hand with *Pachynolophus gaudryi*, and on the other with *Phalangista vulpina* of New South Wales. The dental formulæ of Pleuraspidotherium and Phalangista, are practically identical. The bones of the face are remarkable for the development of the intermaxillaries and nasals, and for the almost complete ossification of the palatine vault. The lower jaw has a broad commissure, as in Pachynolophus, and a special development of the posterior branch recalls Phalangista, but is not inclined inwards.——M. F. Fontannes catalogues the pliocene mollusks of the valley of the Rhone and of Rousillon. These include 195 species of gastropods, of which 44 are new; and 146 bivalves, of which 24 are new. The same writer describes the shells of the freshwater and brackish group of Aix in Lower Languedoc, Provence, and Dauphine, 92 species in all, 11 of which belong to Potamides, 11 to Striatella, 3 to Melania proper, 3 to Ripa, 14 to Lymnæa, and 12 to Cyrena.——M. Neumayr (Neues Jahrb. für Min., Geol. und Palæon., 1884) draws attention to the great similarity between the molars of Tritylodon Owen, from Cape Colony, and the molar of Triglyphus, described by Fraas from a bone bed near Stuttgart.

Quaternary.—A. Mehring (Kosmos, 1883) gives faunistic proofs of the former glaciation of North Germany. Against the "drift theory," he urges that the greater portion of the low-lying parts of North Germany are either entirely free from animal remains, or enclose only land and fresh-water forms, which could not have been the case had a diluvial sea existed. Even the finding of marine animal remains in certain spots can be explained by position from southward moving glaciers. The nature of the deposits and other characters shows that the arctic fauna, the remains of which are found, had its home in the surrounding region.

MINERALOGY AND PETROGRAPHY.[1]

Optical Anomalies in Crystals of the Regular System.—The two well-known theories generally advanced to account for the action on polarized light, exceptionally exhibited by certain regular minerals (vid. Naturalist, November, 1882, p. 926, and Feb., 1884, p. 184) have recently undergone an important modification due to the discovery by Mallard, that sections of boracite, when heated above 265° C., become perfectly isotropic.[2] As is now generally known, Mallard, Tschermak and their followers accounted for these optical anomalies by what is termed "pseudosymmetry," *i. e.*, the imitation, by certain crystals, of a geometri-

[1] Edited by Dr. Geo. H. Williams, of the Johns Hopkins University, Baltimore, Md., to whom all papers for review should be sent.

[2] Bull. Soc. Min. de France, T. vi, 1883, p. 122.

cal form of a higher grade of symmetry than they themselves actually possess, by complicated and repeated twinning. Klein, Krocke and certain other German mineralogists, on the contrary, maintained that the optical peculiarities were produced, not by twinning but by a molecular disturbance due to an internal tension caused by the irregular growth of the crystal.[1] Klein had even succeeded in proving that the apparent twinning lines—the boundary between the areas of different optical orientation—could be made to move by raising the temperature,[2] and the interpretation put by the same writer on the interesting observation of Mallard is very important, as offering a possible means of reconciling the different views which have hitherto existed regarding these anomalous optical phenomena. Klein suggests that the fact that boracite becomes isotropic above 265° C., proves that this substance is dimorphous, crystallizing in the regular system above, and in some other, probably the orthorhombic, below this temperature.[3] The crystals must therefore have been formed at a temperature above 265° C., and hence possess geometrically the regular shape; their internal condition is due to the effort on the part of the molecules to rearrange themselves in accordance with the altered conditions, which is strong enough to produce a profound optical disturbance, but is not able to pull to pieces the crystalline form. Boracite crystals at ordinary temperatures are, in fact, a kind of paramorph, composed of optically orthorhombic portions enclosed in the regular framework in which the substance originally, at a higher temperature, crystallized.

Still more recently Klein[4] has shown that leucite becomes isotropic at high temperatures, and Merian[5] obtained a similar result for tridymite; thus it seems very probable that many other substances, like garnet, analcite, perofskite, senarmontite, etc., which show optical properties in no accord with their external form may be satisfactorily explained by the assumption that they are dimorphous.

Another class of substances like potassium sulphate,[6] leadhillite, aragonite, etc., whose optical properties at ordinary temperatures are in perfect accord with their crystalline form, have been shown capable of transference by increase of temperature to a state where their optical properties have a higher grade of symmetry, and consequently are no longer what the form would require, *e. g.*,

[1] Neues Jahrbuch für Min., etc., 1881, I, pp. 255 and 256.

[2] *ib.* p. 239, *et seq.*

[3] Neues Jahrbuch für Min., etc., 1884, I, p. 239. *ib. ref.* pp. 185 and 186.

[4] Nachrichten d. Kön. Ges. d. Wissensch. zu Göttingen, May, 1884, and Neues Jahrbuch für Min., etc., 1884, II, p. 50.

[5] Neues Jahrbuch für Min., etc., 1884, I, p. 193.

[6] Mallard: Bull. Soc. Min. de France, T. v, 1882, p. 219.

both orthorhombic aragonite[1] and monoclinic leadhillite[2] become uniaxial when sufficiently heated.

MINERAL SYNTHESIS.—Nearly everything heretofore done in the way of artificially reproducing natural minerals and their associations in rocks has been produced in France (vid. NATURALIST, July, 1883, p. 780). Here, however, the results attained have been very interesting and important, and it is to be noticed with pleasure that the broad field which the researches of the French investigators have shown to be so fruitful is beginning to be successfully cultivated in Germany. Professor Doelter, of Graz, commenced, in connection with his colleague, Dr. Hussak, by studying the effects produced on various silicates by subjecting them to the action of different molten rocks.[3] Augite yielded but small results, while hornblende was partially dissolved and changed to an aggregate of opaque grains and microlites of augite, as is often observed in many volcanic rocks. Mica, garnet, olivine, quartz, feldspar, zircon and cordierite were treated in the same manner with different results, which cannot here be enumerated in detail.

A later series of experiments by the same authors for the purpose of obtaining garnet and vesuvianite, if possible, by fusion gave only a negative result.[4] All varieties of these minerals, when melted and again allowed slowly to cool, produced meionite, melilite, anorthite, lime-olivine, lime-nepheline, hematite and spinell, together with more or less amorphous matter, but no trace of the original minerals ever appeared. The fusion of mixtures of the substances entering into the composition of garnet yielded no better results. It would therefore appear that something more than simple dry fusion is necessary to produce these two minerals.

Doelter has still more recently busied himself with synthetical experiments on minerals of the pyroxene and nepheline groups. The lime and potash so often observed in the latter are probably isomorphous mixtures, since small amounts of $Ca\ Al_2\ Si_2\ O_8$ and $K_2\ Al_2\ Si_2\ O_8$, when melted with the typical nepheline molecule, $Na_2\ Al_2\ Si_2\ O_8$ gave homogeneous crystalline masses having all the properties of nepheline.[5] In regard to the aluminous pyroxenes, Rammelsberg holds that the $Al_2\ O_3$ and $Fe_2\ O_3$ are present as isomorphous mixtures with the normal silicate, $\dot{R}\ Si\ O_3$, while the view advanced by Tschermak is, that a silicate having the formula $\dot{R}O$, $\ddot{R}_2\ O_3$, SiO_2 accounts for the alumina and ferric iron. Doelter holds that the latter theory is the correct one, since he has artificially obtained the hypothetical molecule, $\dot{R}O$, $\ddot{R}_2O_3$, SiO_2,

[1] Klein: Nachrichten d. Kön. Ges. d. Wissensch. zu Göttingen, No. XII., 1883, and Neues Jahrbuch für Min., etc., 1884, II, p 49.
[2] Mügge: Neues Jahrbuch für Min., etc., 1884, I, p. 65.
[3] Neues Jahrbuch für Min., etc., 1884, I, pp. 18–44.
[4] Neues Jahrbuch für Min., etc., 1884, I, 158–177.
[5] Zeitschrift für Krystallographie, 1884, IX, 322-332.

and shows that its physical properties are those of pyroxene.[1] An optical examination of a series of carefully analyzed natural pyroxenes also yielded Doelter interesting results regarding the particular constituents which caused an increase in the size of the extinction angle on the clinopinacoid.[2] Wiik[3] attributed this to the amount of FeO present (vid. NATURALIST, Oct., 1882, p. 836), but Doelter considers it rather dependent on the proportions of the molecules Fe Ca Si_2O_6 or $\dot{R}\,\dot{R}_2\,SiO_6$ which the pyroxene contains, in this following the suggestion recently made by Fr. Herwig in his article on the optical orientation of the pyroxene-hornblende minerals.[4]

In this connection may be mentioned among the synthetical work lately produced in France, the artificial production of rhodonite, tephroite, hausmanite, barite, celestite and anhydrite by Alex. Gorgeu;[5] that of apatite and wagnerite containing Br in place of Cl by A. Ditte;[6] and that of albite, orthoclase and analcite in the wet way by Friedel and Sarasin.[7]

The reprint in book form of L. Bourgeois' article on the artificial reproduction of minerals, written for the Encyclopédie chimique,[8] is, notwithstanding Fouqué and Lévy's recent and very complete work on the same subject, a very valuable addition to the literature of this most interesting line of research.

BORON MINERALS.—Rammelsberg[9] has recently published the results of his new examination of the natural borates, which he arranges, starting with the metaboracic acid $\dot{R}_2\,B_2\,O_4$ as the normal, as follows:

Priceite (pandermite) $Ca_3\,B_8\,O_{15} + 5aq = \left\{\begin{matrix} 3Ca\ B_2\ O_4 \\ 2H\ B\ O_2 \end{matrix}\right\} + 4aq$

Boracite (stassfurtite) $2Mg_3\,B_8\,O_{15} + MgCl_2 = 2\left\{\begin{matrix} 3Mg\ B_2\ O_4 \\ B_2\ O_3 \end{matrix}\right\} + MgCl_2$

Hydroboracite $\left\{\begin{matrix} Ca_2\ B_6\ O_{11} \\ Mg_2\ B_6\ O_{11} \end{matrix}\right\} + 12aq = 2\left\{\begin{matrix} \dot{R}\ B_2\ O_4 \\ H\ B\ O_2 \end{matrix}\right\} + 5aq$

Boronatrocalcite (ulexite) $\left\{\begin{matrix} Na_4\,B_6\,O_{11} + 9aq \\ 2(Ca_2\,B_6\,O_{11}+9aq) \end{matrix}\right\} = \left\{\begin{matrix} 2Na\ BO_2 \\ H\ BO_2 \end{matrix}\right\} + 2\left\{\begin{matrix} Ca\ B_2\ O_4 \\ H\ B\ O_2 \end{matrix}\right\} + 12aq$

Franklandite $\left\{\begin{matrix} Na_4\,B_6\,O_{11} + 8aq \\ Ca_2\,B_6\,O_{11} + 8aq \end{matrix}\right\} = \left\{\begin{matrix} 2Na\ BO_2 \\ H\ BO_2 \end{matrix}\right\} + \left\{\begin{matrix} Ca\ B_2\ O_4 \\ H\ B\ O_2 \end{matrix}\right\} + 7aq$

Borax (tinkal) $Na_2\,B_4\,O_7 + 10aq = 2\left\{\begin{matrix} Na\ BO_2 \\ H\ BO_2 \end{matrix}\right\} + 9aq$

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[1] Neues Jahrbuch für Min., etc., 1884, II, pp. 51–66.
[2] *ib.*, 1885, I, pp. 43–68.
[3] Zeitschrift für Krystallographie, VIII, p. 208.
[4] Schulprogramm des Kgl. Gymnasium, Saarbrücken, 1884, pp. 175.
[5] *Comptes rendus*, 1883, XCVII, p. 320, *ib.*, XCVI, pp. 1144 and 1734.
[6] *Comptes rendus*, 1883, XCVI, pp. 575 and 846.
[7] *Comptes rendus*, 1883, XCVII, p. 290.
[8] Paris, 1884, 8vo, pp. 228, VIII planches, Dunod éd.
[9] Neues Jahrbuch für Min., etc., 1884, II, 158–163.

Borocalcite (hayesine) $Ca\ B_4\ O_7 + 6aq = \left\{ \begin{matrix} Ca\ B_2\ O_4 \\ 2H\ B\ O_2 \end{matrix} \right\} + 5aq$

Larderellite $Am_2\ B_8\ O_{13} + 4aq = 2\left\{ \begin{matrix} Am\ BO_2 \\ 3H\ BO_2 \end{matrix} \right\} + aq$

Sussexite $R\ B_2\ O_5 + aq = \left\{ \begin{matrix} R\ B_2\ O_4 \\ R\ H_2\ O_2 \end{matrix} \right\}$ (R = Mn, Mg)

Szaibelyite $Mg_5\ B_4\ O_{11} + 3aq = \left\{ \begin{matrix} 2Mg\ B_2\ O_4 \\ 3Mg\ H_2\ O_2 \end{matrix} \right\}$

Then might be added:

Lagonite $Fe_2\ B_6\ O_{12} + 3aq$

In ludwigite, danburite, datolite, axinite and tourmaline, B is regarded as merely substituted for Al or Fe. In warwickite it would appear to be the same.

The hexagonal mineral from Soktuj, Urals, proved by Damour to be normal borate of alumina, and named by him *jeremeiewite* (vid. NATURALIST, June, 1883, p. 651), has since been investigated by Websky[1] with most interesting results. The substance Al BO^3 is shown to be dimorphous, crystallizing like carbonate of calcium in both the hexagonal and orthorhombic systems. The interior of each crystal is a penetration twin of three orthorhombic individuals, closely resembling those often formed by aragonite, while this pseudohexagonal core is surrounded by an external layer of the really hexagonal modification. Both appear to have the same chemical composition. Websky proposes to retain Damour's name, jeremeiewite, for the outer, hexagonal form, and suggests that of *eichwaldite* for the internal, orthorhombic variety.——The monoclinic mineral, *colemanite* (vid. NATURALIST, September, 1884, p. 925), a hydrous borate of calcium closely allied to priceite, which was recently discovered at Dry lake, in Southern California, has been crystallographically investigated by both vom Rath[2] and Wendell Jackson.[3] By the former the axial ratio is given as 0.7769 : 1 : 0.5416, $\beta = 69°\ 43\frac{1}{3}'$, observed planes + P, — P, — 3P, $3P3'$, 2P, $2P2'$, $P\,\grave{\infty}$, $2P\,\grave{\infty}$, $2P\,\bar{\infty}$, ∞P, $\infty P\bar{2}$, $\infty P\,\grave{\infty}$, $\infty P\,\bar{\infty}$, OP. Jackson determined the axial ratio as 0.774843 : 1 : 0.540998, $\beta = 69°\ 50'\ 45''$. To the planes mentioned by vom Rath are added $\infty P\frac{\grave{7}}{3}$, $\infty P\grave{2}$, $\infty P\frac{\grave{1}9}{10}$, $\frac{68}{11}P\bar{\infty}$, $6P\,\bar{\infty}$, $4P\,\bar{\infty}$, + $P\,\bar{\infty}$, — $P\,\bar{\infty}$, — $\frac{19}{6}P$, $2P\bar{2}$, $3P\frac{\grave{3}}{2}$, $4P\bar{2}$, $\frac{3}{2}P\frac{\grave{3}}{2}$, $3P\grave{3}$, $3P\bar{3}$, — $3P\bar{3}$ and $4P\bar{4}$. In all thirty-one forms, of which twenty-four appeared on one crystal.——C. Bodewig[4] contributes a critical comparison, based on many analyses, of the methods for a quantitative determination of boron in silicates.

[1] Sitzungsberichte d. Kgl. preuss. Ak. d. Wissensch, Berlin, 1883. Neues Jahrbuch für Min., etc., 1884, I, p. 1–17.

[2] Neues Jahrbuch für Min., etc., 1885, I, p. 77.

[3] Am. Jour. Sci., Dec., 1884, p. 447.

[4] Zeitschrift für Krystallographie, VIII, p. 211.

Stibnite.—The stibnite crystals from Japan, which Professor E. S. Dana has recently studied (vide NATURALIST, Nov., 1883, p. 1159) have also been investigated by Krenner[1] at Buda-Pesth and by Brun.[2] The former adds three new forms, $\frac{3}{17}$P, $\frac{3}{13}$P and $\frac{5}{19}$P, to the seventy observed by Dana, making the whole number of forms now known on stibnite, eighty-eight. M. Wada,[3] of Tokio, in a recent paper read in Berlin on some Japanese minerals, gives the correct stibnite locality as Ichinokawa, in the town of Ojoin-mura near Saijo, Province Iyo, Island of Shikoku. Dana's locality is incomplete, since "*Kosang*," in Japanese means "mine," and "*Jaegimeken Kannaizu*," chart of the district of Jaegime.

BOTANY.[4]

SEEDLESS APPLES.—During the past autumn my friend, Mr. C. Gibb, called my attention to some seedless apples of the St. Lawrence variety. They were all from the same tree, and there were originally quite a large number. The normal diameter of the St. Lawrence apple may be given at about $7^{cm.}$ Examination of the specimens showed a somewhat conspicuously flattened form in axial direction; color chiefly yellowish-green; diameter varying from 2.9^{cm} to $5^{cm.}$ Longitudinal and transverse sections gave the same result in each case, and showed (a) complete suppression of the carpels, and so of the ovules; (b) suppression of the vascular structure to such a degree that no fibro-vascular bundles could be seen with the naked eye, as is usually the case.—*D. P. Penhallow, Montreal, Canada.*

WHY FLOWERS BLOSSOM EARLY.—Mr. Meehan in his Native Flowers refers to the early blossoming of *Symplocarpus fœtidus.* In the AM. NAT., Nov., 1883, I tried to show that most spring flowers had their next year's growth well developed in the underground buds of winter, and that spring simply called forth what was already prepared in the winter bud or hibernaculum of the plant. Mr. Meehan says that the flowers of the skunk cabbage must have been prepared to some extent already in the previous winter, and that this may account for their early blossoming. I found this to be entirely correct, and being curious to know the extent of development in our spring plants during the intense heat of summer, I opened a number of the subterranean buds of plants on the 25th and 26th of August. It may be of interest to know that next year's peduncle of the skunk cabbage was 45^{mm} long; the spathe was 55^{mm} long, its upper half being already mottled with purple and yellowish-green; the spadix was 20^{mm}

[1] Földtani Közlöny, 1883, XIII, p. 1.
[2] Arch. d. sciences ph. et nat. Genève (3), IX, p. 514.
[3] Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin, 17 Juni, 1884, 79–86.
[4] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

long. The so-called flower, therefore, was almost half its full size. The flower and peduncle of *Anemone hepatica* were 4^{mm} long; of *Sanguinaria canadensis*, 3^{mm}; of *Arisæma dracontium*, 3$^{mm.}$ The flowers of *Trillium grandiflorum* was 8^{mm} long.

The hibernaculum of *Aralia quinquefolia* in all the plants examined was composed of three scales, the innermost entirely sheathing next year's flowering stalk and also a small bud. The latter is in the axil of the scale, and is destined to produce the flowering stalk two years hence. The leaf of the flower stalk which is opposite to the last scale is always the largest. When the leaves occur in whorls of fours, as was frequent in the specimens at hand, the relative stage of development of the leaves and their position suggested a contracted spiral of leaves rather than a single and sessile twice-compound leaf, as suggested by Gray (Manual, p. 199). The flowers could easily be determined, the outermost flowers being developed the most. In view of the early development in bud of the flowers of spring plants, need their early appearance in spring be surprising? *Aralia quinquefolia* flowers in July, and in August of the same year shows ripened berries and the parts of next year's plant! Is it not rather surprising that with the small amount of vegetation it is compelled to produce, it does not flower much earlier?—*Aug. F. Foerste, Granville, Ohio.*

A Significant Discovery.—In a recent number of *Nature*, Mr. W. T. Thiselton Dyer calls attention to a most interesting and significant discovery in the development of certain ferns. Some months ago Mr. E. T. Druery observed in *Asplenium filix-fœmina*, var. *clarissima*, that the sporangia "did not follow their ordinary course of development, but assuming a more vegetative character, developed more or less well-defined prothallia," which ultimately bore antheridia and archegonia. "From these adventitious prothallia the production of seedling ferns has been observed to take place in a perfectly normal way." The prothallia were subsequently observed by Mr. F. O. Bower to be furnished with root-hairs!

The last-named observer was so fortunate as to discover a still more remarkable development upon *Polystichum (Aspidium) angulare*, var. *pulcherrima*. Here the apex of the pinnules grew out into an irregular prothallium, upon which antheridia and archegonia were clearly made out.

It is a genuine pleasure to note such discoveries, for they are just what we have reason to expect. If, now, so great a change in the ordinary course of development as this is, can take place so suddenly, does it not, to say the least, argue in favor of the *possibility* of similar changes in the past having given rise to the phanerogams? What essential difference is there between these aposporous ferns and the lower phanerogams? The most remark-

able feature about the discovery is the fact that it pertains to pteridophytes of as low a type as the ferns of the Polypodiaceæ. If it occurs there, may we not look for it confidently in the Lycopods, and especially in the Selaginellæ. It may be worth giving a good deal of attention to a careful examination of the greenhouse grown plants of the various species of Selaginella. Apospory in these would possess many interesting features. Who will search for it?

THE HISTORY OF DISCOVERY IN FERNS.—Mr. W. T. T. Dyer gives, in *Nature*, a summary of the progress of discovery with respect to the structure of the reproductive apparatus of the ferns. It is of so much interest that we reproduce it here:

1597	Gerarde	Observed seedling plants near parents.
1648	Cæsius	Sporangia.
1669	Cole	Spores.
1686	Ray	Hygroscopic movements of sporangia.
1715	Morison	Raised seedlings from spores.
1788	Ehrhart	Prothallium.
1789	Lindsay	Germination of spores.
1827	Kaulfuss	Development of prothallium.
1844	Nägeli	Antheridia.
1846	Suminski	Archegonia.
1874	Farlow	Apogamy.
1884	Druery	Apospory.

What better illustration do we need of the slowness of discovery?

DE BARY'S COMPARATIVE ANATOMY OF VEGETATIVE ORGANS.—Between seven and eight years ago there appeared a most valuable contribution to the literature of histological botany from the pen of the great Strassburg professor. In its German form it has been familiar to workers in botanical laboratories, and has been of great service. Now we have an English translation by F. O. Bower and D. H. Scott, which has been brought out under the title of Comparative Anatomy of the vegetative organs of the Phanerogams and Ferns, by the Clarendon Press in England, and placed before the American public by the New York house of Macmillan & Co. In its English form it consists of about 675 octavo pages, having the general appearance both in type, illustrations, paper and binding of the well-known English editions of Sachs' Text Book.

For the benefit of those who are not familiar with the work, we give here its general contents:

PART I. THE FORMS OF TISSUE.

Chap. I. Cellular Tissue. (i) epidermis, (ii) cork, (iii) parenchyma.
" II. Sclerenchyma.
" III. Secretory Reservoirs.
" IV. Tracheæ.
" V. Sieve-Tubes.
" VI. Laticiferous Tubes.
" VII. Appendix. Intercellular spaces.

PART II. ARRANGEMENT OF THE FORMS OF TISSUE.

§ 1. Primary Arrangement.

Chap. VIII. Tracheæ and Sieve-Tubes. (i) Arrangement, (ii) structure, (iii) development.

" IX. Primary parenchyma.

" X. Sclerenchyma and Sclerotic Cells.

" XI. Secretory Reservoirs.

" XII. Laticiferous Tubes.

" XIII. Intercellular Spaces.

§ 2. Secondary Changes.

Chap. XIV. Secondary growth in thickness of normal dicotyledonous Stems and Roots. (i) Cambium, (ii) wood, (iii) bast.

" XV. Secondary changes outside the zone of thickening.

" XVI. Anomalous thickening in Dicotyledons and Gymnospores.

" XVII. Secondary thickening of the Stem and Roots of Monocotyledons and Cryptogams.

The publication of this work in this form will do much to stimulate a more exact study of the minute anatomy and development of the various organs of plants, and will, we trust, do not a little towards placing botanical work in this country upon something of the same basis as that of zoölogy.

JOURNAL OF MYCOLOGY.—There has been a feeling for a long while that this country should have a journal of mycology in which should be published all the descriptions of new species of fungi. The matter was talked over somewhat in Philadelphia last September by members of the Botanical Club of the A. A. A. S., and it has now so far taken form as to result in the issuance of a prospectus. It is to be "edited by J. B. Ellis, Newfield, N. J., and W. A. Kellerman, Manhattan, Kan. It will be issued about the 1st of each month, contain from twelve to fifteen pages, and be devoted exclusively to mycological botany, special attention being given to the North American Fungi. It will contain descriptions of new species as they appear from time to time; another leading feature will be the publication of monographs of different genera, with descriptions of all the North American species known—thus making, in fact, a manual of our fungi. A full account will also be given of all the current literature pertaining to this subject."

We bespeak for this much-needed journal a liberal patronage. The business management will be in the hands of Dr. Kellerman, to whom subscriptions ($1) should be sent.

BOTANICAL NOTES.—Friedlænder & Son, the well known booksellers of Berlin, have just issued three very valuable catalogues of books treating of cryptogamic plants. They are Nos. 357, 358 and 359, and we feel that we are doing good service to botanists in this country by calling attention to them.——J. G. Baker's Syn-

opsis of the genus Selaginella in the *Journal of Botany* has reached the 219th species, and is still to be continued.——L. A. Bailey continues his Notes on Carex in the January *Botanical Gazette*, describing one new species, *C. nervina*, and one new variety, *C. muricata*, var. *confixa*, both from the Pacific coast.——Dr. Vasey, in the last *Torrey Bulletin*, describes three new grasses, viz., *Stipa scribneri* from New Mexico, *Festuca confinis* and *Elymus saundersii*, both from Colorado.——In the same journal H. W. Ravenel gives an account of a monster grape-vine in Beaufort county, S. C., which at the ground measures fifty-nine and a half inches in circumference, and "at two and a-half feet from the ground, where it divides into two branches, fifty-seven and a-half inches in circumference."

ENTOMOLOGY.

THE FLIGHT OF THE ROBBER FLIES DURING CONNECTION.—Both fly vigorously though their heads are in opposite directions, the female, by her greater size, controlling the course. The difference in pitch of the two sets of wings is very striking.—*F. E. Todd.*

NOTES ON THE MOUNDS OF THE OCCIDENT ANT.—The mounds built by the *Pogonomyrmex occidentalis* can hardly fail to attract the attention of any observing traveler.

A neatly smoothed bare spot, from three to five feet in diameter is found in the grass and in its center is a mound of quite symmetrical form. This mound is frequently covered entirely with coarse sand or fine gravel, even when the surrounding surface shows little of this material.

It would seem, at first, that the ants, guided by some instinct, selected the material which would best secure their structure from the wind and the rain.

During the past season the writer has found opportunity to test this point. A little watching showed that the excavation below the surface and the building of the mound are carried on by two different sets of workers, one continually bringing out particles from within and dropping them upon the court or bare space around the mound, the other picking up particles from the surface of the court and depositing them upon the mound. The coarseness of the material seems to be determined by the desire of a worker to find as large a particle as he can conveniently carry. For instance, when, as in the case observed, the crust of the ground was broken by the tramping of a horse, medium sized pieces were deposited upon a mound, but none of the smallest and of course none of the largest, as ants have not learned to work otherwise than individually. When particles of broken glass were scattered upon a court they were quickly found and in spite of their angular and polished surface were soon carried and dropped upon the mound. The coarseness and uniformity of the material,

therefore, seems readily explained by the principal stated above. Whether the mound shall eventually be formed of gravel depends upon its abundance in the particular locality.—*J. E. Todd.*

NOTES ON THE BREEDING HABITS OF THE LIBELLULIDÆ.—The following observations, though incomplete, are offered because there is no prospect that the writer can pursue the subject farther, at least not for some time.

In the month of July, '82, while camping near Bear creek, Dakota, on a bright, breezy day, his attention was attracted to numbers of dragon-flies hovering over the surface of the water. Many of them were in the usual position when pairing. The male holding the female by the back of the head with his claspers.

From the bottom of a deep clear pool various water-plants came to the surface, and as the water was rippled by the breeze, their tops were occasionally thrown out of the water. Many dragon-flies were noticed hovering about, especially around the tops of these plants; the female evidently endeavoring to gain a footing upon them. In a short time one was successful and immediately folded her wings backward and commenced crawling down the stem into the water. The male meanwhile was forced to let go to prevent his being dragged into the water. I could see the females until they were about a foot below the surface of the water but of course could not trace them to the bottom which must have been at a depth of from three to five feet. They seemed the more conspicuous because of the quantity of air which adhered to their abdomen and wings. After losing his companion the male hovered about, resting occasionally upon the grass at the border of the pool, and evidently watching for the return of the female.

I was unable to determine, very satisfactorily, the length of time which the female remained below the surface, but after the first one observed disappeared below the surface fully half an hour passed before I saw one reappear. This one appeared struggling upon the surface of the water and was quickly seized by one of the males with his claspers. She seemed to have torn her wings so as to be unable to fly, but it may have been that they could not be promptly used on account of being wet. The male after seizing her towed her to shore, being apparently unable to lift her from the water. A male falling accidentally upon the water was not similarly rescued. The water was more or less infested with fish and it seems not improbable that many of these venturesome insects sacrificed their lives in devotion to their progeny.

Other pairs of the same or closely similar species were observed about the edge of the water, the female evidently fastening her eggs to the under-side of sticks and stems of weeds by extending her abdomen below the water while resting upon them. The species was not recognized and conveniences for collecting and pre-

serving were not at hand, but it resembles quite closely another species which has been determined by Dr. Hagen as *Lestes unguiculata*. The latter species, at another locality, was found depositing eggs in the stems of bulrushes and cat-tails, the male accompanying the female in a position similar to that in the first species named. The female saws a hole through the skin with her ovipositor and deposits the egg in the pith. Similar localities have been diligently watched by the writer during the past two seasons, but it has not been his privilege again to see the dragon-flies go below the surfacc of the water. The laying of eggs in the stems of bulrushes is a very common sight about the marshy ponds and streams of Dakota.

The different stages or positions in the process of copulation in the dragon-flies are very interesting and sometimes puzzling, but as a general rule they seem to be as follows:—at least it is so with the genus Lestes. First, the male seizes the female by the back of the head and flies some time with her in this position before the second stage is reached, in which the male, still holding the female, curves his abdomen and charges the seminal sac, then resumes the first position. The female seizes the abdomen of the male with her feet and brings the tip of her abdomen forward and receives the seminal fluid from its receptacle From the third the fourth is readily reached by the female withdrawing her abdomen and letting go with her feet or not as the case may be. In the species of Lestes before referred to the fourth position corresponds to the first. It seems not improbable that after laying a number of eggs the female may return to the second position and become fertilized for a second brood. The length of time which is occupied evidently varies considerably. In some cases I have observed, the males and females united during their rest at night. Another curious habit observed, especially in a large olive-green species of Æschna, is this: while flying at full speed the insect dashes flat upon the surface of the water in a pond and, apparently by the rebound, recovers its position in the air. This may serve the purpose of a bath, clearing the wings of dust, or possibly of parasites.—*F. E. Todd, Tabor, Ia., Jan. 10, '85.*

The Number of Abdominal Segments in Lepidopterous larvæ.—In connection with our examination of the caterpiller of Lagoa we have made an examination of the caterpillars of each of the families of Lepidoptera in order to ascertain whether there was any variation in the number of segments to the body and whether there were any more than five pairs of abdominal legs. We find that no caterpillars known to us have less than ten abdominal segments or uromeres. The ninth segment, however, is liable to be much reduced in size and to be more or less coalesced with the tenth or anal segment. The ninth segment is most rudimentary in the Sphinges, where it is very short, though yet dis-

tinguishable; beneath, the segment is distinct on the sides, but obsolete in the middle.

In the larval butterflies the ninth segment is rather more distinct than in the Sphinges, but it is short; the tenth segment is as in all caterpillars represented by the supra-anal plate and anal legs.

In the Ægerians, Zygænidæ and Bombycidæ, the latter especially, the ninth segment is very distinct. In Halesidota the ninth segment is quite long, forming an entire segment, with its own set of hair-bearing warts, the urite, or ventral surface is quite distinct from the infra-anal plate or tenth urite. In Datana the ninth segment is longer than the supra-anal plate; in *Lochmæus tessella* with its long anal filaments, the homologues of the anal feet, the ninth segment is distinct from the tenth; in an allied Notodontian with elongated anal legs, the ninth segment is unusually long and distinct. In *Telea polyphemus* there are ten abdominal segments, counting the supra-anal plate and anal legs as the tenth; in *Hyperchiria io* and Clisiocampa the ninth is distinct from the tenth segment

In *Limacodes scapha* and *P. pithecium* there are no traces of legs; the number of abdominal segments appears to be ten.

In the Noctuidæ the ninth segment is distinct, with a series of verticils above and a well marked ventral portion or urite.

In the geometers the ninth segment is distinct above but below merged into the infra-anal plate. In the Pyralid caterpillars, as well as the Tortricids and Tineids, the ninth segment is longer and more distinct than in the higher families.

Although the indications are slight, yet the Bombycidæ, as we have previously remarked, seem to be the oldest, most generalized group of Lepidoptera, and it is a question whether the Pyralids, Tortricids and Tineids are not degenerate forms which have descended fron the Noctuidæ and ultimately from the Bombycidæ; there are indications that the Noctuidæ have descended from the geometers, since the young of the Plusiæ and Catocalæ, &c., have three pairs of abdominal legs, being semi-loopers when hatched, and afterwards acquiring the additional pair of legs. At any rate the primitive caterpillar had ten pairs of abdominal legs.

It will be remembered that the saw-fly larvæ (*Lophyrus*) have eight pairs of abdominal legs, while the embryo honey-bee has tenpairs of temporary abdominal appendages.—*A. S. Packard.*

Entomological Notes.—Studies on the organs of flight in the Hymenoptera, by Dr. Amans, appear in the Travaux de Laboratoire de zoologie de la Faculté des Sciences de Montpellier et de la station Zoologique de Cette, 1884.——In *Psyche* for June–July, 1884, W. C. Krauss describes in detail, with sketches, the brain and nerves of the head and mouth-parts of *Corydalus cornutus*. ——In the *Zoologischer Anzeiger* for Nov. 15, 1884, Dr. J. E. Rombouts discusses the mode of progression of flies on smooth sur-

faces, and concludes that the fluid by which flies adhere to smooth surfaces is not sticky, that they need no adhesive secretion and that if the fluid were pure water or olive oil it would act the same and that the fly's power of walking on a smooth surface is due simply to capillary attraction. A firm adhesion of the hairs to smooth surfaces, which Hepworth in 1854, and Dahl and Simmermacher consider as necessary, he finds not to exist.——A memoir of great value on the anatomy of a Myriopod (*Lithobius forficatus*), with four colored plates and wood-cuts, but unfortunately wholly in Russian, was published in 1880, by N. Sograff in the Moscow Transactions.——In the Bulletin of the Brooklyn Entomological Society, Nov., 1884, Mr. G. Gabe claims that *Rhyssa lunator* is not a true ichneumon, but a true wood-feeder. The breeding habits are described, and the mode of oviposition. During the process the long ovipositor is bent, passed between the posterior legs, the abdomen is elevated almost to a right angle with the thorax, and the ovipositor, guided by the anterior tarsi is forced with a ramming motion into the wood to the depth of from two or three inches. He has watched many females ovipositing and has cut off the ovipositor when ready to be withdrawn, and in no instance has he found a larva of any kind anywhere near the point reached by the borer, and where the egg was deposited. Messrs. Hulst and Weeks stated that they had reached the same conclusion from independent observation.——During the past winter Prof. Packard has given a series of talks or lectures to the Providence Entomological Society on the structure and habits of insects, in order to aid those members whose time does not permit them to obtain a general knowledge of the subject.——The veteran French Coleopterist, Auguste Chevrolat, died Dec. 16th, in his 86th year.

ZOÖLOGY.

Function of Chlorophyll in Animals.—L. von Graff, dissatisfied with the conclusions of Brandt as to the symbiotic relations of what the latter regards as green algæ to *Hydra viridis*, and with the methods of his experiments, arranged three specimens of *H. viridis* in eight different vessels; four of them, A, B, E and F, he exposed to the light; A, B, C and D were filled with water from an aquarium. In E—G the water was filtered. In A, C, E and G the water was changed daily, in the others it was never changed at all. The first Hydra to die was one in glass G, on the thirty-first day of exposure in which the filtered water was changed daily, and the light shut off. The glass A did not lose a specimen till the 109th day of observation, when one died. In C in which the aquarium water was changed daily, and light shut off, the three specimens died on the 105th, 106th and 109th days; B, in which the water was not changed, and which was ex-

posed to the light, only lost one specimen, and that on the 100th day.

Dr. Graff concludes that the Algæ or pseudochlorophyll bodies of Hydra have no significance as means of nutrition; the fact that all the specimens in filtered water died by the 87th day seems to show that the Hydra died from the want of animal food, and that the green bodies do not serve as such, as Brandt supposes. The most unexpected and perhaps the most remarkable fact is that whether the Hydræ were exposed to the light or placed in the dark, they in all cases retained their green color through life.

Dr. Graff has lately been able to make some observations on the *Mesostoma viridatum*, three out of five examples of which were richly provided with chlorophyll-corpuscles; these varied very considerably in size, and no nucleus was to be detected in the smaller specimens; starch granules of proportionate size to that of the chlorophyll-bodies were found in them. The larger green bodies were arranged in closed groups, and the smaller examples lay between the groups; most of the bodies were rounded, but a few of the larger were oval.—*Journ. Royal Microscopical Society, Dec., 1884.*

A Free-Swimming Sporocyst.—The egg in the digenetic Trematode worms, as is well known, does not at once give rise to the adult Distome, but to a brood-sac which produces directly or indirectly in its interior a greater or less number of larval Distomes. The brood-sacs live parasitically within mollusks, and are known as rediæ or sporocysts, according as they have, or have not, a rudimentary intestine. Neither rediæ nor sporocysts are possessed of much locomotive power, but this appears to be in inverse ratio to the number of the contained brood. The sporocyst of *Cercaria micrura*, *e. g.*, which contains only a few larvæ is decidedly active. Sporocysts are commoner than rediæ, and exhibit a greater variety of form. Thus Moulinié distinguishes sacciform, cylindrical and tubular sporocysts, a classification which corresponds fairly well to the form of the contained brood. The sacciform sporocysts generally contain the ordinary tailed larvæ or Cercariæ, but the tail may be very short as in *C. micrura* Filippi, or entirely absent as in *C. globipora* Ercolani, again the cylindrical sporocysts produce Cercariæ with furcate tails like *C. furcata*, and the remarkable Bucephalus-larvæ are produced in branched tubular sporocysts.

The object of the present note is to indicate the existence of a hitherto unknown form of sporocyst, one specimen of which I observed recently swimming very actively in an aquarium containing a few water plants and fresh-water mollusks. In form and size it recalls the larger Cercariæ with forked tails, and contains a single tailless Cercaria or larval Distome. In accordance with its free life, the muscular system is much better developed than

usual, and the same is true of the water-vascular system. Of especial interest are tactile papillæ, which beset the surface, and which obviously enable the sporocyst to find the definitive host for its contained larva. These papillæ are somewhat more complicated than the similar structures described by Fischer from the neighborhood of the cirrus-pouch of *Opisthotrema cochleare* (Zeit. wiss. Zool. XL, 12). In a future paper I propose to give a full account of the structure of the sporocyst and its contained larva. It would be premature to attach any specific name to the Distome, as it may turn out to be a well-known form, but I am at present unable to offer any suggestion as to its "whence" or "whither." I examined the mollusks in the aquarium for other specimens in vain, and, in the hope of obtaining others for infection experiments, hardened and sectioned the only one I had secured.

Professor Leuckart, to whom I communicated the substance of the above, writes: "Your observation is certainly calculated to astonish helminthologists. I doubt whether the creature is really free-living, but believe that, in place of the Cercaria, it represents only the swarm-phase of the parasite. An entirely free-living sporocyst, without intestine, would hardly find the conditions necessary for a complete existence. It probably lives parasitically within a mollusk, and wanders out after development of the contained larva, in order to seek a suitable host for the latter. Perhaps it may attach itself to the host by the flat lobes of the forked tail, and then discharge the larva imprisoned within it."—*R. Ramsay Wright, University College, Toronto, Jan. 12, 1885.*

STRUCTURE OF ECHINODERMS.—C. F. Jickeli has a preliminary note in which he states that he has made experiments confirmatory of the doctrine of Carpenter as to the nervous system of Comatula. He finds that a single arm gives no response when the ambulacral groove is touched with a needle or stimulated by an electric current, but that the moment the needle touches the point at which the axial cord lies the arm is strongly flexed, and the pinnulæ more actively. A single cirrus when stimulated appears to be thrown into a tetanic condition. Many of the author's experiments are in exact agreement with those of Carpenter. After the removal of the visceral mass irritation of the capsule produces a synchronous contraction of all the arms. If a few drops of osmic or acetic acid are put in the water, the "torso" moves as actively as an uninjured animal.

The author describes the structure of the cirri, and the processes which pass from the "spongy organ" into them. The observations of P. H. Carpenter that nerve-branches pass into the dorsal and the ventral muscles is confirmed. A series of sections shows that the ambulacral nerve diminishes in extent as it approaches the intestine, and finally disappears. Attention is

drawn to the fact that Götte describes the epithelium of the so-called ambulacral groove of Comatula as being endodermal in origin.

A third nerve-center is described as being present in the connective tissue, and as forming a pentagonal cord around the mouth. The lateral cords are connected by branches with one another at the angles of the pentagon, and they extend along the water-vascular system; each of these cords gives off lateral branches at regular distances, and these innervate the water-vascular system, and the papillæ of the tentacles. Other well-developed branches are also given off to the ventral integument of the body, where they are lost in a fine nervous plexus. Ludwig's view of the glandular character of the tentacles appears to be incorrect. They have 3–4 sensory hairs and a centrally-placed slowly-moving flagellum. From these observations it would follow that the tentacular papillæ are complicated sensory organs.—*Journ. Royal Microscopical Society, Dec., 1884.*

Affinities of Onchidia.—R. Berg, after discussing the views as to the affinities of the Onchidia, which have been held by preceding writers, protests against the doctrine that they are nudibranchiate mollusks, and claims them as decidedly pulmonate; their nervous system does not differ essentially from that of the Pulmonata; it only differs in having the lowermost part more condensed and reduced, the opthalmophores are like those of the stylommatophorous Pulmonata, and the pedal glands have very similar relations, as has too the digestive system. It is true that the Onchidia are "opisthobranchiate," but so are Arion and Limax; in this group, at any rate, the position of the heart has no systematic significance. The kidney is very like that of the Pulmonata, and the difference between the sizes of the lung-cavity is to be explained as due to the largely cutaneous mode of respiration in the Onchidia. The most striking proofs of relationship are to be found in the structure of the generative system; the seminal duct has a position in the lateral wall of the body, such as has never yet been demonstrated in any Nudibranch, but only in the Pulmonata. The Onchidia are Pulmonata which have adapted themselves to an amphibiotic or marine mode of life.—*Journ. Royal Microscopical Society, Dec.*

Zoological Notes.—*Polyzoa.*—The Polyzoa of the *Challenger* Expedition have been described by Mr. Geo. Busk, who finds that out of 286 species of Cheilostomatous Polyzoa, no less than 180 are new. The Reteporæ alone have been raised from 31 to 60. In the North Pacific four species were procured from 3125 fathoms. Certain species have a great bathymetrical range. *Cribrilina monoceros*, one of the four taken in 3125 fathoms, was in the South Pacific taken in 1325 fathoms; from 69 fathoms near Kerguelen; from 55 in the South Atlantic, and from 35 in

the Australian region. As a rule, however, the species having the wider geographical distribution are those from the shallower depths. Another exception to this rule is the genus Catenicella, rich in species, and almost confined to shallow Australian seas.

Mollusca.—*Nature*, in reviewing Dr. R. Bergh's report upon the Nudibranchs collected by the *Challenger*, remarks that few shallow water dredgings were made during the cruise, and thus it is not strange that only twenty-five species were found. The majority of them are Phylliroidæ and Æolidiadæ, and are pelagic; some are littoral, as *Janclus australis*, of which a single specimen was taken in the Arafura sea. Another, *Cuthonella abyssicola*, was taken by the trawl in Farœ channel at 608 fathoms. Some new Tritoniadæ and Doridídæ are described, and among the latter the most interesting is *Bathydoris abyssorum*. The body of this species is semiglobular, as in the genus Kalinga of Alden and Hancock, and it resembles this genus also in having branchiæ composed of several separate branchial tufts, as well as in the presence of soft conical papillæ on the back. It has no frontal appendage, and a very slightly pronounced dorsal margin, and seems to connect the Doridídæ with the Tritoniadæ. The only specimen was taken in 2425 fathoms in the middle of the Pacific. The body of the living animal was gelatinous and transparent, the foot dark purple, the tentacles brown, and the gills and other external organs orange. One specimen only of the Onchidiadæ, *O. melanopneumon*, was taken in shallow water at Kandara, Fiji. Dr. Bergh believes these animals to have no relation to the Nudibranchs.——Mr. J. R. Davis (*Nature*, Jan. 1), assert that limpets have a settled home, for they occupy scars on the rock, often sunk to a considerable depth. He marked and watched specimens to prove this, and found that, though a marked limpet might move about three feet from its scar in any direction, in search of food, it always found its way back. A limpet always returns before the rising tide reaches it, and roosts with its snout pointing in the same direction. Mr. Davis asks what sense is used? The eyes of a limpet, mere sensitive cups, can at most distinguish different degrees of light intensity; the examples deprived of their tentacles found their way back, and repeated washing of the track with sea-water in order to destroy scent did not prevent the limpets' return.

Stelechopoda.—Dr. L. von Graff has described the Myzostomida of the *Challenger* collection. Myzostomes are small disk-like animals which were attached to crinoids, and their cysts have been found upon the stalks of fossil Pentacrini. Dr. von Graft requests any palæontologist having crinoids under his care to examine the specimens, and, if he should notice little pustules at the base of the pinnules, to communicate with him. Graff's class Stelechopoda embraces the Tardigrades, Linguatulids and Myzostomes. The forms before known were characterized by the

peculiar radial arrangement of the organs of the body, but among the sixty-seven species here described are many which are without this radial arrangement, while in Stelechopus not even the muscular septa and parapodal muscles are convergent. This fact strengthens Dr. von Graff's previous idea that the radial symmetry was an adaptive change due to fixation. Several forms are entirely without suckers, while in *M. calycotyle* the suckers are stalked. The Myzostomes are diœcious, but the sexes unlike. When inhabiting the same cyst the female is usually from fifty to a hundred times larger than the male.[1]

Crustacea.—Dr. P. P. C. Hoek found complemental males in nineteen out of the forty-one new species of Scalpellum gathered by the *Challenger* Expedition. Some of those complementary males do not show a division of the body into capitulum and peduncle; a second section still without such division has rudimentary valves; a third has valves, capitulum and peduncle. Darwin's "true ovaria" are believed to be pancreatic glands.

Birds.—Dr. W. Buller (Trans. N. Z. Institute, 1883) furnishes notes on some rare New Zealand birds. *Sceloglaux albifacies*, the laughing owl, has been found in deep fissures of the limestone rocks at Albury, near Timaru. Examples were procured by a process of smoking-out. In this species the male is the larger bird, and has a harsher cry than its mate. The four captured by Mr. Smith became quite tame, and in matters of food showed a decided preference for young rats, though they would eat mutton, beetles, lizards and mice. Their call on waking up at nightfall was "precisely the same as two men cooeying to each other from a distance." (The cry known as coo-ey is the call-note of Australasian settlers.) The rock-crannies in which they live by day and build their nests are dry, narrow at the entrance, and often five or six yards deep. They become almost naked while molting, and in this state two of Mr. Smith's birds were stung to death by a swarm of bees.——It appears that small birds such as the silver-eyes (Zosterops) and the English sparrow are in New Zealand often killed by adhesion to the viscid carpels of *Pisonia brunoniana* or *P. sinclairii.*

Pisces.—In a letter received by Professor Liversedge from Mr. Caldwell, the latter states that the eggs of Ceratodus measure about $2\frac{1}{2}^{mm}$ in diameter, and have the protoplasmic pole darker, as in the Batrachia. The egg is surrounded by a strong closely-investing gelatinous membrane about $3\frac{1}{2}^{mm}$ thick. The segmentation is complete. "Part of the blastopore remains open, and persists as anus. The stages up to hatching closely resemble those of Amblystoma. After hatching, the larva goes into the mud. It lies on its side like Pleuronectidæ among the Teleosteans, and the oldest stages I have reared still show no traces of external gills. The larval changes, I expect, will continue for many

[1] Mr. S. A. Miller has probably already characterized this order from fossil specimens.

weeks." Mr. Caldwell states that he will leave a large number of the larvæ in an aquarium at the station in Queensland, and will also bring a supply of eggs to Sydney to rear in the laboratory.—*Nature.*

EMBRYOLOGY.[1]

ON THE TRANSLOCATION FORWARDS OF THE RUDIMENTS OF THE PELVIC FINS IN THE EMBRYOS OF PHYSOCLIST FISHES.—The two great subdivisions into which the species of Teleost fishes are divisible, viz., the Physostomi and Physoclisti, stand to each other in the relation of the unspecialized and the specialized in respect to the evolution of the paired fins. The members of the group Physostomi tend to retain the pelvic limb more or less nearly in its primordial position throughout life, and no marked tendency towards the approximation of the rudiments of the anterior and the posterior limbs seems to be exhibited by the embryo, as may be seen upon studying the development of a form as typical of the group as the salmon or trout. Such retention of the primordial posterior position of the pelvic fins by the embryos of Physostomes supplements those other more unspecialized traits which they possess, viz., the open pneumatic duct, persistent throughout life, and the simpler or more primitive condition in later life of the *paraglenal* elements (coraco-scapular plate in the embryo), commonly differentiated in the adult into hyper-, meso- and hypocoracoid, in Gill's nomenclature, whereas in the Physoclisti the mesocoracoid is suppressed. The frequently persistent protopterygian condition of a portion of median dorsal fin-system, developed as a so-called adipose fin, is another embryonic character retained by many Physostomes.

While the foregoing characters are unquestionably of value as determining the relative position of the two groups under discussion, I would now call attention to some embryological phenomena which demonstrate beyond any doubt that the Physoclisti have descended from the Physostomi.

In the young larva of Lophius, or the angler, taken from the egg shortly before hatching, A. Agassiz[2] has shown that the pectoral and pelvic fin-folds arise, the latter behind the former and almost synchronously, as lobate diverticula of the epiblast, into which mesoblast has been thrust outwards, and with their bases nearly horizontal. In this relation of position as anterior and posterior paired outgrowths they develop just as do the rudiments of the paired fins of the Physostomous salmon embryo; but the two pairs of fins are much more nearly synchronous in making their appearance, and are much closer together. The figure of the youngest stage of the angler given by Agassiz shows that there are but four myotomes opposite the interval be-

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

[2] On the Young Stages of Osseous Fishes, Part III, 20 plates; Proc. Amer. Acad. Arts and Sciences, Vol. XVII, July, 1882 (Plates XVI, Figs. 2–5, and XVII, XVIII).

tween the pelvic and pectoral fin-folds, whereas in the young salmon, relatively somewhat older, there are at least sixteen myotomes opposite the interval between the pelvic and pectoral fin-folds. This fact would seem to indicate that the tendency to shift the pelvic limb forwards must have commenced to manifest itself far back in the ancestral history of Lophius.

The sudden translocation of the pelvic fin of Lophius, which now follows in the next stage figured by Agassiz, gives us a clear conception of how the jugular or thoracic position of the pelvic limbs of Physoclists has been brought about. It also clears away the difficulties which Haswell and Fürbringer have encountered in reconciling the condition of the nerve supply of such shifted fins with the theory of the origin of the paired limbs from continuous folds or serially homologous rudiments, as developed by Balfour and Dohrn. For, in the next stage, we find the base of the pelvic fin suddenly swung round, down and forward through an arc of nearly 90°, so as to carry the whole structure below the base of the pectoral. This shifting is then carried still further, so that the bases of the pelvic fins are finally situated below and in front of the insertion of the bases of the pectorals. The other equally singular and extraordinary embryonic changes undergone by Lophius we cannot discuss at present, but would refer the reader to the original memoir.

This remarkably sudden shifting of the pelvic fins of Lophius embryos, within a period of twenty-four hours, is a fine example of saltatory development, or of how a sudden developmental leap may be manifested, which does not very seriously involve adjacent structures. Embryonic development is, in fact, everywhere diverted from its archetypal mode, so to speak, by such interference with the primordial synchrony or primitive order in time and space of the appearance of different organs. It is the business of the philosophical morphologist to keep in mind the import of such phenomena, and to weigh their significance in the discussion of the evolution of organic forms.

The nerves, vessels, muscles and bones appertaining to the successive rays of the median fins are, as is well known, derived from embryonic metameres which are simply more developed or differentiated in the adult. The cartilaginous rays or *actinophores*[1] of the paired fins of the Elasmobranchs and the rays of the unpaired fins of Teleosts are known to sustain such a relation of homonomy to the primary metameres first indicated in the embryo, though in some types two, three or even five actinophores may stand in a derivative relation to such a single embryonic segment or somite. There is also much ground for the belief that in the paired fins of Teleosts it is possible to trace such a relation between the somites over which they originally arose and the actinosts or actinophores which constitute their axial skeletons,

[1] The most peripheral skeletal elements which afford support to the true fin-rays of the Lyrifera.

much as the Teleostean paired fins have been specialized and altered in the course of the history of the phylum.

If it is, therefore, found difficult to trace the nerve supply of the pelvic fins which have been thus shifted into a jugular or thoracic position to segments above them, or to reconcile their mode of innervation with the lateral-fold theory of their origin proposed by Balfour, the comparative anatomist who confines himself to the study of adult structures should not be surprised, for he can know nothing of the translocation of the whole fin-rudiment forward and downward unless he is acquainted with the process which brings this about. Neglecting this, he remains ignorant of what embryological investigation and investigators might do for him, though he will often criticise the conclusions of the latter upon the basis of his knowledge of adult structures, which, as in the case above instanced, would manifestly be insufficient to enable him to get at the truth. This interesting example of the value of embryological observations as the basis for deductions in scientific morphology, reminds the writer of what Bruch[1] has said, to the effect that, "In the kingdom of nature, as in history, all that has *become* is to be understood only through its *becoming*."

Lophius is an extreme type, yet other equally interesting forms have been described, traced and figured by Mr. Agassiz; for example, Gadus does not bud out the rudiments of its pelvic fins so early as Lophius, though another form, Mallotus (= Onos), seems to bud out the pelvic limb nearly as soon as the embryo angler. Gadus is evidently intermediate.—*John A. Ryder.*

Development of the Viviparous Edible Oyster.[2]—In this essay, the text being duplicated in Dutch and French, Dr. Horst brings together about all the information of value which has been acquired by his predecessors and contemporaries, and also gives an account of his own investigations, especially those which relate to the development of the shell-gland and gastrula, which he had, however, first published two years ago. The gastrula is the first to be invaginated; this is followed by the invagination of the shell-gland on nearly the opposite side of the blastula.[3] The mouth is formed at the time of invagination of the gastrula; the anus is formed later, and is broken through at the end of the gastrular pouch of endoblast, which blends with the ectoblast, which also becomes perforated where the two blend. The mantle cavity is formed by the appearance of a space between the posterior mar-

[1] "Alles Gewordene, im Reiche der Natur, wie in der Geschichte ist nur durch sein Werden zu begreifen, und die Entwickelungsgeschichte ist in diesem Sinn für den Naturforscher vollkommen dasselbe, was die Weltgeschichte für die Menschheit" (Wirbeltheorie des Schädels).

[2] De ontwikkelingsgeschiedenis van de œster (*Ostrea edulis*), door Dr. R. Horst, and Embryogénie de l'Huître (*Ostrea edulis*, L.), par le Dr. Horst, Tijdschr. der Ned. Dierk. Vereen. Suppl., 1884, pp. 1–63, 1 pl., Leiden.

[3] In this, his observations are not in agreement with Brooks' observations on *O. virginica*, in which that author finds the invagination which leads to the development of the shell-gland to coincide with the blastopore.

gins of the larval valves, lined with ectoblast (mantle), into which the vent opens. The anterior adductor muscle degenerates after fixation, when its function is assumed by the posterior adductor, which develops after the former. The cephalic ganglion originates from an epiblastic thickening situated in the center of the trochal disk or velum. The larval shell is homogeneous; but at the hinge there are two small teeth separated by an interval from each other.

The earlier stages are copied from Möbius, who incorrectly represents the nucleolus of the ripe egg as being spheroidal, whereas the writer has shown it to be a double body in the ova of the three species, including *O. edulis*, investigated by him.[1]

Dr. Horst's more recent investigations upon the early growth and fixation of the fry or veliger stage of *O. edulis* and its metamorphosis into the "spat" are of great and significant interest. Carrying out more fully a suggestion made by the writer in 1881, Dr. Horst used a wooden frame, into which could be fixed a large number of glass slides, such as are used by microscopists. This frame, with its contained slides, some of which were coated with hydraulic cement, was immersed for a period of seventy-two hours in waters where free-swimming oyster larvæ were known to exist, at the end of which time spat was found adhering to the slides, measuring 0.24^{mm} in height ($\frac{1}{104}$ of an inch). After fixation, which seems to occur in the same way as in the American species, the permanent shell is formed or built up by the mantle beyond the margins of the valves of the fry, a homogeneous membrane, subdivided internally into polygonal spaces or areas, being first laid down by the mantle border. In these prismatic areas of the periostracum, calcification occurs by the deposit of calcic carbonate, and the shell is thus moulded upon the membranous matrix of conchioline. Attachment and growth of the young edible oyster, according to Horst, is very similar to that of the American species, as described by the writer (Bull. U. S. Fish Commission, ii, 1882, p. 383). The outgrowth of the first branchiæ as two series of distinct ciliated processes projecting into the mantle cavity of the spat is interesting as showing that the more primitive condition of the lamellibranchiate gill was much simpler than in the existing adult oyster.

PHYSIOLOGY.[2]

The Temperature Sense.—By an ingenious device Dr. Pollitzer has been able to make what are probably exact determinations of the sensitiveness to heat of the skin in different parts of the body. The rounded bottom of a small platinum cylinder was heated to a constant temperature by means of benzole spray. The cylinder was raised or lowered by a rack and pinion arrangement and the distance between cylinder and skin was determined

[1] Bull. U. S. Fish Commission, II, 1882, p. 213.
[2] This department is edited by Professor Henry Sewall, of Ann Arbor, Mich.

at which the radiant heat could just be perceived. The relative sensitiveness of the skin in different parts is calculated as being inversely as the squares of the distances measured. The following table indicates the relative sensitiveness to heat of different parts of the skin, the sensitiveness of the palmar surface of the third phalanx of the index finger being considered as 100:

Finger.	Dors. Hand.	Back.	Forearm.	Palm.	Calf.
100	204	204	270	294	314

It follows from the observations made that, "1. The relative sensitiveness to heat in different parts of the body is not the same in different individuals. 2. It differs much less in different parts of the same individuals than the sensitiveness to pressure or power of localization, the greatest difference for heat being as three to one; while for pressure it is at least as five to one, and for localization as sixty to one. 3. The parts in which the other cutaneous senses are most acute are not the same as those in which there is greatest sensitiveness to heat. 4. Of the parts examined, the tip of the index finger is the least sensitive; in the other parts where the sense of locality is from five to thirty times as dull, the thermal sense is from two to three times as acute. 5. The thermal sensitiveness bears no definite relation to the thickness of the epidermis." On the contrary the time necessary for an increase of temperature to be perceived depends directly upon the thickness of the epidermis which is heated (*Fl. Physiology*, Vol. v, p. 143).

Drs. Lombard and Walton seek to explain temperature sensations as the outcome of mechanical stimulation of sensory nerves whose endings are submitted to strain due to unequal expansion of the two layers of the skin when its temperature is changed. These authors find that various fresh animal tissues, as tendon, expand when warmed, and contract when cooled; others, as elastic tissue, contract when warmed and expand on cooling; the epidermis, separated by maceration, is scarcely affected by temperature, while the skin as a whole acts like elastic tissue. It appears, then, that tensions between dermis and epidermis would be brought about by changing the temperature of the skin. In the experiments referred to the temperature was varied between 0° and 63°C.—*Centralbl. f. Med. Wiss., 1883, No. 32.*

Rhythmic Contraction of the Capillaries in Man.—Local and obscurely automatic rhythmic contraction of the bloodvessels is an established fact. Wharton Jones found that the veins in the bat's wing underwent rhythmic expansions and contractions even after there was good reason to suppose that the influence of extrinsic nerve centers was excluded. Such venous contractility must be a very important factor in the circulation of the blood. An artificial current of blood forced under constant pressure through the vessels of an excised, but living muscle, undergoes alternate acceleration and diminution which can only be explained by changes in the caliber of the muscular vessels.

Dr. Lauder Brunton describes a simple experiment, but not one very easy to verify, by means of which rhythmical contraction and dilatation of the capillaries in man may be demonstrated. If the finger-nail be drawn once or twice up and down the middle of the forehead a red streak remains which may persist many minutes. This streak undergoes variations in width and brightness, some of which correspond to the heart-beat, others to the movements of respiration, and still another series have a slower rhythm of some twenty seconds interval; these last changes probably have their origin in purely local contractions of the capillary walls.—*Jl. Physiology, Vol. v, p. 14.*

The Piston Recorder. — Schäfer describes a very simple device for registering graphically the variations in volume of a frog's heart, which may find quite general application. The organ whose changes of volume are to be measured is inclosed in a vessel filled with fluid which communicates with a horizontal glass tube of 3–4 ^{mm} diameter containing oil. A disk of platinum fits closely in the tube and is in contact with the oil column whose movements it follows perfectly without allowing the escape of oil round its rim. An aluminium rod of proper length, bearing a writing point at one end, is fastened to the center of the platinum disk, and the piston rod passing through a hole in a cap at the end of the glass tube is kept moving in the center of the latter. —*Jl. Physiology, Vol. v, p. 130.*

The Origin of Fibrin formed in the Coagulation of Blood. —Research upon the cause of blood clotting has been rendered very difficult because of rapidity of the process of coagulation in the blood of most animals. Dr. Howell has discovered that the blood of the terrapin clots very slowly and offers unequaled advantages for the study of its chemical changes. A sample of this blood left in a refrigerator at 15° to 20° C. was found still perfectly fluid at the end of a week; the corpuscles had completely settled leaving a deep layer of clear plasma above. A very careful series of experiments led the author to uphold that view of coagulation according to which the process is due to the transformation of a single chemical body, fibrinogen, which exists pre-formed in the blood plasma, into fibrin under the influence of fibrin-ferment, which is a product of the dissolution of white blood corpuscles. —*Stud. Biol. Lab. Johns Hopkins Univ., Vol. iii, p. 63.*

Voluntary Acceleration of the Heart-Beat in Man.— There are on record a number of well-authenticated cases in which the rate of heart-beat seems to have been under easy control of the will. As is well known, the pulse rate and character is normally profoundly influenced by the emotions, and there is little doubt that in most of the cases recorded the alteration in heart rhythm was brought about indirectly through the excitement of the appropriate psychical condition. In fact, simple concentration of the attention on the heart movement is sufficient, in most

cases, to alter the regularity or rate of its rhythm, and it is probably impossible for one to make an accurate estimate of his own pulse. But there are several instances in which the connection does not seem to have been so clear. Tüke investigated the case of an old man who at will could increase his heart rhythm by twenty beats per minute. A Lieut. Townsend could restrain respiration and heart beat until he fell into a death-like condition and the body began to grow cold. Professor Tarchanoff reports a series of experiments carried out on a student who could voluntarily hasten his heart-beat from about 90 to 120 beats per minute. The patient declared that this acceleration was not preceded by any special emotion, and mere thinking of the condition would not produce it, but that a direct and fatiguing effort of the will was necessary to cause the quickening. Comparative measurements showed that during the acceleration there was no constant alteration of the respiration, but that the blood pressure uniformly rose with the heart beat.—*Pflüger's Archiv. Bd., 35, p. 109.*

PSYCHOLOGY.

INTELLIGENCE OF A SETTER DOG.—In the winter of 1880 I purchased in the East a dog puppy out of a purely bred English Gordon setter bitch, by the well known prize-winning Irish water spaniel, Bramton Barney.

He was the only puppy in the litter and no other puppies came from the same cross, for the reason that the bitch died soon after, and bringing the puppy here he was named Barney, and keeping him in the office where there were several persons employed, his exceeding good nature was courted and his naturally pleasing (aside from his determination), yet nervous disposition was encouraged.

After a little training Barney took to retrieving, but his more noticeable traits was the working up of some mischievous act of his, which, though puppy-like, would at times be so unlike the ordinary as to appear to the observer as original.

In the spring following, when but about six months old, he retrieved his first duck from water, and this one being a wounded ruddy duck made the young "dropper" labor hard to make good the catch and bring the bird to me, as it was yet alive.

From this time on there seemed no difficulty in getting him to go for a wounded or dead bird at any time, but owing to his exceedingly stubborn nature he was very hard to govern in such manner that he would perform the service as work and not as play. At all times he was making new surprises, but only minor ones until the coming fall, when he was about one year old. At this time I was hunting in a marsh near here and had walked out into the water to a depth of about two feet and some one hundred yards from shore, breaking the ice which, by the way, was not very thick. Barney without a whine followed after me and without

noise remained by my side until the first duck was dropped, which was in time nearly half an hour, and the duck fell in the open water seventy-five yards away.

The ice was not quite strong enough to hold up the dog and in his struggles to get through about fifty yards of the ice before reaching the open water he had a very tedious time of it. At last he reached the duck and taking it in his mouth, swam first towards the broken ice which he had made and then turning to one side broke a new path away, but not in the direction of where I was standing, but in a direct line for the shore, deviating only as forced to evade a too heavy growth of rushes. Arriving upon shore he placed the duck alongside of some ammunition sacks I had left near a log, and upon the log and overcoat, thinking that perhaps this would have a tendency to drive the ducks and other birds coming up near the bank to shear off towards my blind in the rushes. His desire to get to this log in as short a way as possible was evident, for as soon as he dropped his duck, he at once pulled the coat off the log, but to the east side and, lying down upon it kept only his head exposed to the piercing north-west wind as it struck the right side of the log which lay almost parallel with the points of the compass north and south. This he continued during my shooting for the forenoon, only changing when I shot a duck, when he would at once run as rapidly as he could to the channel he had made—swim out to where the duck had dropped, pick it up and return to place it with the first and then to again resume his position behind the log, with his head above on the lookout.

Even as he grew in years his good nature of puppyhood did not forsake him; in the kennel he was the popular dog. All the female dogs and puppies, liked him and it seemed to him the greatest pleasure when a puppy was being hurt to rush up and chase the abuser away. He was also given to particular fancies. Some men he did not like, while others instead he was particularly fond of.

As a companion he was with me going down the Arkansas river, in the winter and spring of 1882; to Labrador, in the summer of the same year and many other nearly similar trips. Different from most dogs I have observed; while he at times was as jealous as any, at others he was quite indifferent. His human acquaintances named him the "noble dog," and this must have been a like opinion among his canine friends.

In the kennel where he was kept for a considerable time were quite a number of dogs and bitches, and scarcely at any time but that there were a number of puppies there also. In this kennel was one highly bred pointer of large size, a powerful animal, but with a very miserable disposition.

It was an almost continuous occurrence for Barney to play with one or more of the puppies, permitting them to pull his ears, tail and other parts of the body; sometimes when three or four of

them would take position at opposite points, and pull with all their strength, he did not growl or get vexed, for at such times he was in his element and enjoyed it the more when he could jump high into the air to frighten his young friends.

The pointer instead would not permit a puppy to approach him, in fact had so bitten a couple that they had died.

From some cause this pointer, Wad, and Barney were the worst of enemies, and in consequence there were many battles, and the pointer being the more powerful would have ruined his foe, were it not for the support of one of the bitches—an Irish water spaniel.

This bitch, Frank, would rush up at once upon seeing Barney thrown under his adversary and catching the pointer by one of his hind legs, start off with a sudden jerk; the result would be that Barney would once more come to his feet and in the end because of his being shaggy would get the best in the fight with the vicious, yet plucky pointer.

In all these fights should Barney get bitten so that blood would be shown there seemed to be a perfect panic amongst the bitches and puppies.

One instance in particular is noticeable. Returning to my office one afternoon I observed many people running towards the kennel, which was in the rear of the office.

A workman who had been engaged in the kennel was hurriedly running up the street to me. He said that Barney, and the pointer were having a big fight, and that Barney, assisted by the bitches, was eating up the pointer.

Upon arriving within the kennel my greatest surprise was to see the grown bitches chasing Wad—whose coat naturally pure white was now covered with blood—around the yard as rapidly as could be, Frank the more savage of the number; while Barney with a lot of puppies around him was assisted by them in licking his wounds. The workman, who at the time the fight began was at work on the south side of the kennel in cleaning out a bathing tank, informed me that Wad was lying in the shade of the high fence at that side and that Barney went over to him and taking hold of Wad's ear led him away from this shady place to the north side of the kennel where the sun shone very hot. Here he left him and at once went back to the shady place to lie down, from which he had so unceremoniously taken Wad.

The workman, who was a stranger and had been at work there only a few days, attempted to drive Barney away, but instead Barney growled and would not leave—showing plainly his disposition to attack the workman.

Wad had followed Barney, but did not offer fight until after Barney's growling, when he at once rushed upon him. In a few moments Barney was the "under dog" in the fight and continued so until Frank as usual came to the rescue. This she did, sev-

eral times catching Wad by one hind leg and giving Barney a chance to get up again.

Several witnesses who climbed up and saw the fight over the high board fence corroborated this part of the statement by the workman.

When I saw Barney after the fight he was lying in the chosen place he had driven Wad from, with all the puppies and bitches around him.—*To be continued.*

ANTHROPOLOGY.[1]

THE PROTO-HELVETIANS (*continued*).—The age of bronze shows a marked advance on preceding ages. The villages of that period were more extensive, the dwellings, as is shown by the planks and main timbers which still exist, larger. In each village there appears to have been an open place where work was undertaken that could not well be done indoors. The discovery on the sites of the lacustrine villages of Neuchatel and Bienne, of molds, crucibles, metal broken for the melting pot, damaged and half-repaired tools and weapons, is sufficient to disprove the theory that the workshops were on the land. There is reason to believe that the stations of the bronze age, unlike those of the stone age, were more or less contemporaneous. Except in unimportant details, the remains of that period hitherto brought to light possess the same general features, and none of the villages appears to have outlived the others.

Some of the swords of the bronze age are elegantly shaped and exquisitely worked. They were probably worn by the chiefs, and served rather as badges of authority than as weapons of offense. The form of them is that of a willow leaf, and their length varies from seventeen to twenty-three inches. The blades are generally ornamented with several parallel bands and fastened to the hilt with rivets. One of the finest specimens found at Lorcas, in addition to the bands, is ornamented with a series of punctured lines, and the hilt, which is bossed in the center, has a short cross-guard. The total length of the blade is 23.89 inches (sixty-seven centimeters), the hilt measures only eight centimeters. None of the hilts are much larger, and judging by the size of their weapons, the lake-dwellers must have had remarkably small hands.

The hilt of a sword found at Mœrigen appears to have been ornamented with ivory or amber, and its blade of cast bronze is inlaid with thin plates of iron, the metal, which is now the commonest of all, being in that age the most precious. The blades of all these swords are straight and pointed, and designed rather for thrusting than for cutting.

But the gem of Dr. Gross's collection is a steel sword found at Corcelettes. The fact that it is steel has been proved by analy-

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

sis, and the specimen is unique among lacustrine finds. The blade, which has suffered somewhat by fire, is 25.58 inches long, straight and pointed, and the waved lines with which it is embellished are evidently the work of some pre-historic engraver. Who were the forgers of this weapon is a question Dr. Gross discusses at some length and, having regard to the undoubted skill of the Lacustrians as metal workers and to other circumstances, he leans decidedly to the opinion that it was wrought by themselves; yet seeing that no other arm of the same material has been found elsewhere, the correctness of this conclusion is perhaps open to doubt. Among the objects brought to light by the labors of Dr. Gross are bronze daggers, highly ornamented hatchets, chisels, gouges, knives, hammers, anvils, needles, tools for net-making, fishing-tackle, buttons, chains, spoons, spearheads, arrow-points and rings, bracelets and other ornaments in great variety. Strange to say, saws, though they seem to have abounded in the stone age, are rarely found among the vestiges of the age of bronze. The total finds of them in the Swiss lakes do not exceed half a dozen, of which two are in the collection of Dr. Gross. One was found at Mœrigen, the other at Auvernier, and both appear to have been used as frame saws. Another interesting find was that of a distaff at Lorcas (a stone age station) and a bundle of linen yarn, which, if it were not slightly carbonized, might be passed off as having been spun yesterday. No remains of looms have been found, but the discovery of linen tissues in great variety proves that the Proto-Helvetians were adepts both in weaving and spinning. They were also skilled mat, net and basket makers. It might be going too far to affirm that the lake-dwellers wore shirts and employed laundresses, but it is a fact that there have been found, at Mœrigen, bronze studs exactly like the studs which now adorn the fronts of gentlemen's shirts, and double buttons in no way distinguishable from the *solitaires* used for fastening wristbands. Ornaments of gold are not often met with in the ruins of lacustrine villages; nevertheless, two plates of the precious metal, embellished with parallel lines, a double and a single spiral, and a twisted fillet, have been found at Mœrigen and Auvernier. The objects appear to have been used as collars, or, possibly, as badges of princely rank. The single spiral bears a striking resemblance to a spiral found by Dr. Schliemann in the ruins of Troy. Until the discovery, eleven years ago, of a bronze bit at Mœrigen, it was not suspected that the Proto-Helvetians added horsemanship to their other accomplishments, and even for some time afterwards, the find was looked upon as the product of a later age, which had found its way into the lake by accident. But the subsequent finding at Mœrigen, Corcelettes, and elsewhere, of bits, broken and entire, a chariot wheel and bones and skeletons of horses, put an end to all doubts on the subject. Some of the bits are remarkable speci-

mens of metallurgic art. One of them is a sample of the type still in common use, both in England and on the continent. The mouth-piece is jointed in the middle and twisted, the cheeks are furnished with "dees" for holding bridle and curb-chain; and in shape and fashion the Proto-Helvetian bit differs hardly at all from the "snaffle" of English grooms and harness-makers. But it is much smaller (nine centimeters, 3 50 in. long.) than the modern bit, a fact which, together with the smallness of all the equine bones that have come to light, points to the conclusion that the horses of the bronze age were little, if any, larger than Exmoor ponies.

Professor Virchow, to whom Dr. Gross has submitted the skulls found by him at Auvernier, declares that the brain capacity of the lake-men was equal to that of the men of our own time. Their conformation, their cerebral volume, the peculiarities of their sutures, place them on an equality with the highest type of Aryan skulls. That people so richly gifted by nature should have succeeded so remarkably in the struggle for existence, affords no grounds for surprise. There was nothing in common between the lacustrine communities and the savage tribes whom a fatal law condemns to extinction so soon as they come under the influence of a civilization higher than their own. The lake-dwellers possessed a singular aptitude for progress, a rare capacity for adapting themselves to their environment, and making the most of their advantages.

The skulls examined by Dr. Virchow are doubtless those of individuals who fell into the water by accident, possibly at the time of the great fires in which nearly all the villages of the bronze age seem to have perished; for the discovery at Auvernier of a place of sepulture, shows that the lake-dwellers disposed of their dead by laying them in the ground. This cemetery contained the bones of about twenty individuals, and the presence among them of stone and bronze articles, their positions on the lake shore, opposite a range of piles, leaves no doubt that the remains are of lacustrian origin. The appearance of the ground denotes the existence of many other tombs; but the cost of exploring them has hitherto hindered the making of further explorations.

As touching the antiquity of the lake-dwellings of Proto-Helvetia, there is very little to be said. No medals, coins, or other relics, whereby the date of their erection can even be approximately determined, have been found. It may, however, with certainty be inferred, from the absence of anything Roman, that the lacustrian vanished from the scene before the appearance in Central Europe of the legions of the eternal city. According to the calculations of Von Sacken, moreover, the Necropolis of Hall stadt, which is admittedly more modern than the lacustrian stations, dates from about 500 A. C., and as there is good reason to believe that several centuries elapsed between the destruction of

the lake-dwellings, and the making of the Necropolis, the former event must have come to pass 800 to 1000 years before the Christian era. The duration of the ages of stone, copper and bronze, is a matter of pure conjecture. All that can be regarded as certain, is that it was very long. In the opinion of Dr. Gross, and of other erudite Swiss antiquaries, several series of centuries —perhaps twenty or thirty—must have elapsed between the time when the first piles were driven into the beds of the Swiss lakes, and the time when lacustrine civilization reached its highest development. We shall probably not be far out, then, if we assign to the oldest of the lake-dwellings an antiquity of not less than six thousand years.—*Contemporary Review, July, 1884.*

Western Tribal and Local Names.—Recent investigations of a linguistic purport on the Western States and Territories have yielded many interesting results, which may be fully relied on, because they were made and verified on the spot. Of *tribal names* we mention the following:

Bidai, a tribe in Southern Texas, of unknown affinity. The Caddo term bidai means *brushwood, thicket.*

Kichai, a tribe affiliated to the Wichita tribe; from the Wichita term kítsa, *water.* The Wichita Indians call a Kichai Indian, Kiétsash kuétsa, the Red river of Louisiana: Kitchka.

The *Caddo Indians* once were in the habit of wearing nose-rings, and are still called by other tribes "Pierced-Noses." The Káyowē style them Mōn-sépti, the Comanches Nasomoni'hta; "ring-nosed." They call themselves Assínai, which is the name of a populous tribe once seen in the center of Texas, by C. de la Salle (about 1683).

The *Cheyenne people* is called Sie-nawó nē and Páka-nawo nē[1] by the Còmanches; the first name: "striped feathers" refers to a headdress (siya *feather*), the other: "painted arrows" is derived from pák *arrow*, nábor "striped." The Káyowē name for that people, 'Ahiadl, is said to refer to their homes near cotton-wood trees.

The *Apaches* of Arizona are called by the Comanches Hútashi or with the full form: Hûtâshi náp: *moccasins turned up at the toes.* Né ura'htó hútashi náp signifies: "I wear moccasins turned up," and a "pug-nose" is called múi tár;

Among the local names we point out the following:

Mobitēe, a rising town in the Panhandle of Texas, is called so from the Comanche term: móbitai, *walnut.* Several creeks and rivers in the vicinity are called by the same name.

Abilene, a town and railroad station of Northwestern Texas: from avèlino, the Mexican name of the peccary or musk-hog, frequent in some portions of Texas and old Mexico.

Ozark, the name of this ridge is of French origin, and a muti-

[1] Nē, or ném is the Còmanche term for *people.*

lation of *bois aux arcs*, "wood for bows." The species of trees is the osage orange, used for bows and for making hedges; when cut green the wood never shrinks in seasoning.

Skullyville, name of a settlement in Arkansas, and of another in the Chá'hta Nation, Indian Territory. Probably derived from the French provisional term *escalin*, Spanish *escalino*, a coin twelve cents and a half in value. It is derived from the English *shilling*, and has passed into the Chá'hta language in the form: iskúla.

Prairiedanne, village in Arkansas: corrupted from French: *Prairie dinde* (d'Inde, coq d'Inde) or "turkey prairie."

Sangamon river, Illinois; a corruption of Saint Germain river.

Chilocco, name of an Indian training school in northern part of Indian Territory, near Arkansas city. Named after a streamlet in the vicinity, and representing the Creek term tchí-'láko, *horse* ("large deer").

Wolf river is the name generally given by Indians of the Indian Territory to the North fork of the Canadian, near which Fort Reno is built. The Comanches call it, and the fort also, Ìssa húnubi (ìssa, *wolf*, húnub'h, *river*).—*A. S. Gatschet.*

THE HISTORY OF RELIGION.—As now employed, the word religion may be taken to include all human beliefs and actions with reference to the spirit world. Of course, in employing it, we shall be sometimes talking of creeds, again of conduct, a third time of the organization of society into clergy and laity, and finally of the apparatus employed in all so-called religious actions. For the purpose of collecting and classifying all accessible information regarding the subjects above-named, excluding controversy about dogmas, M. Guimet has established the Musée Guimet at Lyons, and founded the Revue de l'Histoire des Religions, under the supervision of M. Jean Réville. The journal is of the highest scientific value, and proves its rights to a place in literature by closing its ninth volume, in its fifth year.

The contents of this volume, in brief, are as follows:

The Pratimoksha Sûtra, from the Thibetan. M. W. Rockhill.
The Ballad of Lenore in Greece. **J. Psichari.**
Sacrifices of Carthage at the persecution of Decius. **M. Massebieau.**
Review of Müller's "Greek Mythology." M. Reville.
The great solar Goddess, Ama-Terasow Oho-kami. De Rosny.
Belief in future life among the Jews. **E. Montet.**
The Myth of Osiris. J. Lieblein.

A great portion of the volume is devoted to reviews and Bibliography.

MICROSCOPY.[1]

THE BRAINS OF URODELA.—The following method of preparation is extracted from Professor H. F. Osborn's papers[2] on the brains of American Urodela, and from a letter in which the details are more fully given.

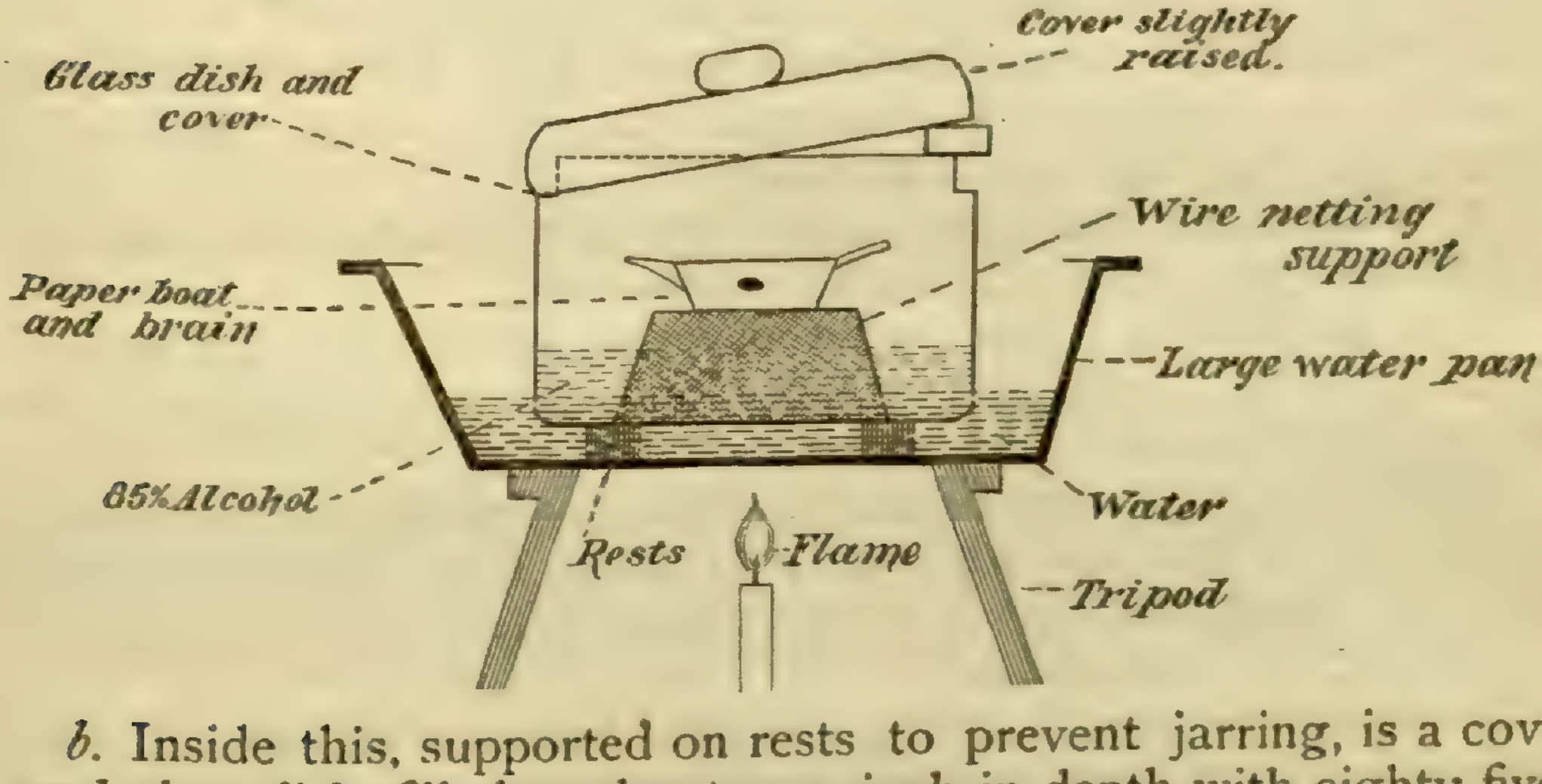
[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.
[2] Proc. Acad. Nat. Sc. of Philadelphia, 1883, p. 178, and 1884, p. 262.

"Before hardening the brains were inflated with Müller's fluid, so as to preserve the natural proportion of the cavities. After treatment with alcohol, they were placed for a week in dilute carmine. Calberla's egg-mass was employed as before, except that *the ventricles were injected with the mass before hardening.* The delicate parts of the brain-roof were thus retained. It appears now that celloidin may be used for this purpose to equal, if not to greater advantage in results, and with considerable economy of time. The sections were cut in absolute alcohol, were then floated upon a slide in consecutive order, from twenty to fifty at a time, and were covered with a delicate slip of blotting paper during treatment with oil of cloves."

Imbedding.—1. The egg-mass was prepared by shaking the white and yolk of egg together, with three drops of glycerine to each egg, and then well filtered through coarse cloth.

2. The bath is then prepared as follows:

a. Outside is a large water pan for boiling with the Bunsen burner, &c.



b. Inside this, supported on rests to prevent jarring, is a covered glass dish, filled to about one inch in depth with eighty-five per cent alcohol.

c. Within the glass dish is placed a piece of coarse wire netting which supports the imbedding box, raising it above the alcohol.

3. The box, made of paper in the usual way, and one-fourth filled with the imbedding mass, is kept in the bath until the mass is hardened enough to support the brain. The brain is next placed on the hardened stratum and covered with the fresh mass. The second stratum is hardened just enough to hold the brain in place, and then a third is added, filling the box.

4. The whole mass must now be allowed to harden through and through, requiring about fifteen minutes.

5. The hardening is completed by passing the box through three grades of alcohol—eighty, ninety and a hundred per cent, allowing it to remain twenty-four hours in each.

When the mass becomes nearly white and ceases to discolor the alcohol, it is ready for cutting.

SEMPER'S METHOD OF MAKING DRIED PREPARATIONS.—Semper's method, published in the Sitzungsber. d. phys.-med. Ges., Würzburg, 1880, and in the Zoolog. Jahresbericht for 1880, has been redescribed in detail by Dr. Sharp.[1]

1. Place the object in a weak solution of chromic acid (¼–1 per cent), six to twenty-four hours, according to its size and nature. For small animals, such as annelids, gastropods, frogs, mice, &c., six to eight hours are sufficient.

2. Transfer to a large quantity of clean water, which must be often renewed until the acid has been so far withdrawn that the water remains uncolored by it. This part of the process may be much shortened by allowing a current of water to flow through the vessel. The usual time is from ten to twenty hours.

3. Treat with thirty to forty per cent alcohol ten to twenty-four hours, with sixty to seventy per cent alcohol two or three days (with larger objects a week), with ninety per cent alcohol two or three days or more, and finally with absolute alcohol.[2]

4. Transfer to turpentine and leave it until it becomes thoroughly saturated (two to three days). With large objects it is best to change the turpentine once.

5. Place the preparation in the air, in order to evaporate the turpentine, protecting it carefully from dust.

The preparation soon becomes white, resembling the whitest kid. It is light, stiff and, on account of the resin contained, perfectly insect-proof.

If hollow organs (stomach, bladders, lungs, &c.) are prepared, they may be inflated with air after they have remained a short time in turpentine, by so doing much space, and consequently much alcohol, are saved.

Professor Semper keeps his preparations in dust-proof, glass boxes, in which they can be seen from both sides.

To the five steps of the process a sixth, discovered by Semper a few years ago, is given by Dr. Sharp. It consists in placing the prepared object in a solution of glycerine and sugar, which brings back almost entirely the original color in many cases.

RABL'S METHODS OF STUDYING KARYOKINETIC FIGURES.[3]—*Material.*—The skin and kidney of Proteus and the epithelium of the mouth of salamander larvæ. The epithelium is the more favorable object, as the very large nuclei can be examined in sur-

[1] Proc. Acad. Nat. Sci. Philad., 1884, pp. 24–27.

[2] The treatment with absolute alcohol is the most critical part of the whole process. *Absolutely* every particle of the water must be removed; for any tissue in which it remains will become spotted and eventually spoil. Dr. Sharp always takes the precaution of changing the absolute alcohol once or twice, and leaves the object in it three to seven days.

[3] Morph. Jahrb., X, H. 2, pp. 215–219, 1884.

face preparations. The achromatic spindles are seen to best advantage in the renal tissue.

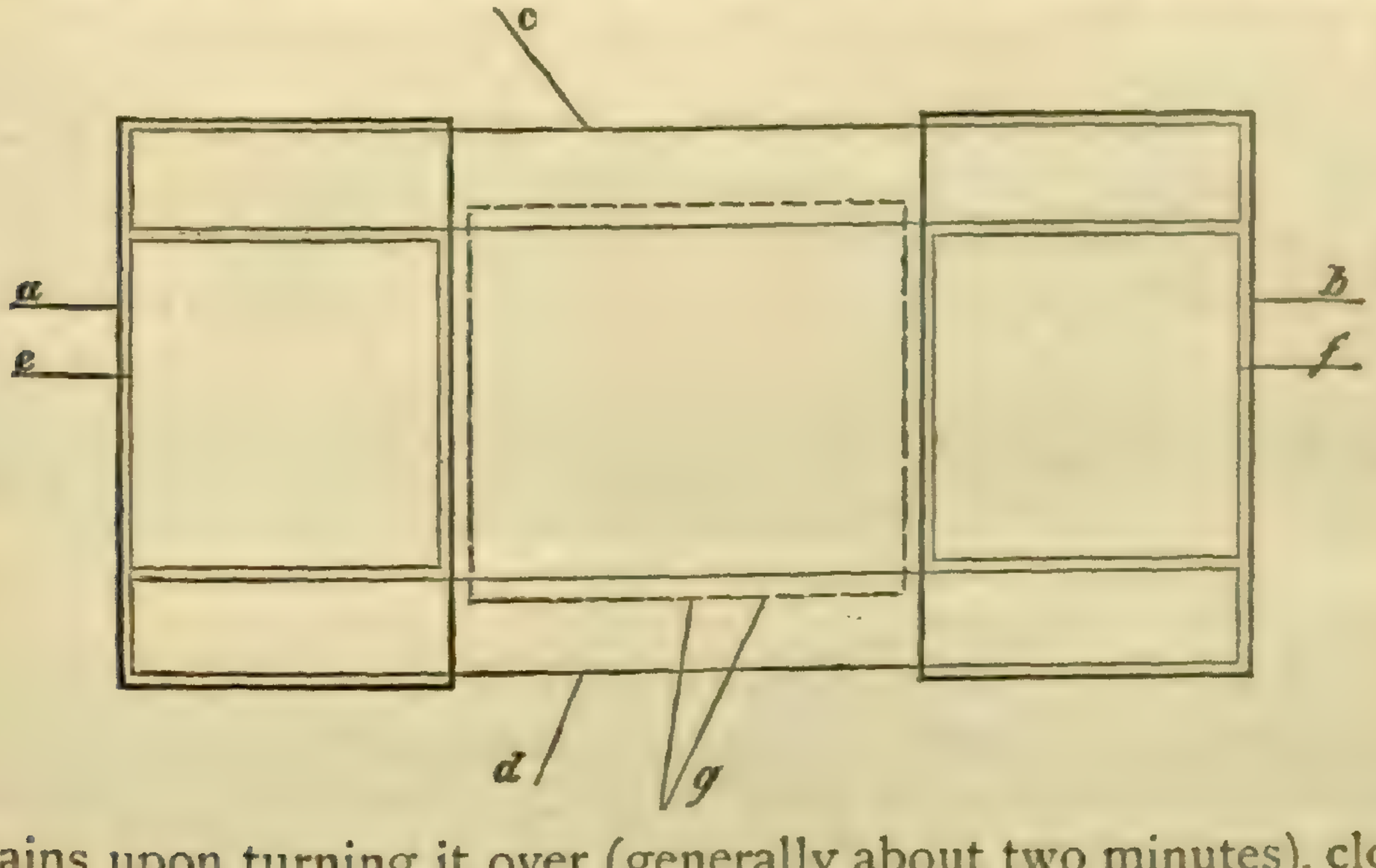
Preparation.—a. Place small fresh pieces of the object in *chrom-formic acid* (200 g. of a one-third per cent solution of chromic + four to five drops of strong formic acid) twelve to twenty-four hours.

b. Wash thoroughly and harden slowly, first twenty-four to thirty-six hours in sixty to seventy per cent alcohol, then in absolute alcohol.[1]

c. Stain in either of the three following ways:

1. *Grenacher's hæmatoxylin* (strongly diluted with distilled water) twenty-four hours, followed, after washing, with acidulated alcohol (few drops of HCl.).

2. *Pfitzner's safranin* two to four hours, followed by absolute alcohol, in which the object is left until no visible cloud of color



remains upon turning it over (generally about two minutes), clove oil a few minutes and dammar.

3. Double-stain with hæmatoxylin and safranin; stain very feebly with the hæmatoxylin; wash and treat with acidulated alcohol, and then stain with safranin as in number 2.

Examination.—High powers are required in the study of the mounted preparation, either the homogeneous immersion $\frac{1}{18}$ of Zeiss, with Abbe's condenser, or that of Hartnack, No. III, $\frac{1}{24}$. Nachet's camera was employed in drawing.

It it well to work with green light, which can be obtained by inserting a green colored glass plate beneath the table of the microscope, as was first recommended by Engelmann.

The slide devised by Rabl enables one to examine a prepara-

[1] Instead of the chrom-formic acid a ⅓ per cent solution of *platinum chloride* may be used, the preparation otherwise remaining the same. Chrom-formic acid causes the chromatin filaments to swell somewhat, so that their longitudinal division generally becomes obliterated; while platinum chloride causes a slight shrinkage, which brings out very distinctly the division of the filaments as well as the chromatin-spherules of Pfitzner.

tion from both sides. It consists of four pieces of glass of the shape and size seen in the figure (*a b c d*), and a cover-glass, *g*, which serves as the object-bearer. The two glasses, *a* and *b*, are painted on one side with chloroform balsam, and then connected by means of *c* and *d*. The frame thus formed is completed by adding the pieces, *e* and *f*, between *c* and *d*. The frame is next turned over and the middle portions of the glass bars, *c* and *d*, painted with balsam; and a thin glass cover, *g*, placed so as to rest on the pointed sides of *c* and *d*. This glass (*g*) bears the object in dammar, which is covered by another very thin glass. The object, lying between two thin cover-glasses, can be viewed from both sides with the highest powers.

THE PREPARATION OF MEROBLASTIC OVA.—*A. Reptilian Ova.*[1] —1. The ova taken from the oviduct are opened in a dilute solution of osmic acid (one per cent) and then the white removed as far as possible.

2. The osmic acid is then turned off and a weak solution of chromic acid (⅓ per cent) added, twenty-four hours.

3. With a sharp, fine pair of scissors cut around the germinal area, just outside its margin; and after it has been completely encircled with the incision, float it carefully off from the body of the yolk.

4. The yolk and acid are next removed, and a copious supply of clean water added, which must be several times renewed.

5. Calberla's fluid (glycerine, water and absolute alcohol in equal parts) three hours.

6. Hardened in ninety per cent alcohol.

7. Stained in Böhm's *carmine acetate* twenty-four hours.

B. Teleostean Ova (T. fario).—1. Chromic acid (⅓ per cent) twenty-four hours.

2. Distilled water two hours. The egg-membrane expands, and may now be easily removed.

3. Washed in distilled water twelve hours.

4. Absolute alcohol, glycerine and aq. dest. in equal parts four hours.

5. Absolute alcohol.

6. Böhm's carmine acetate one to two days.

7. Mixture of water (fifty vols.), glycerine (fifty vols) and muriatic acid (a half vol.), for a few minutes.

8. Washed in water, four to five hours.

9. Absolute alcohol twelve hours, preparatory to imbedding in paraffine.

BÖHM'S CARMINE ACETATE.—1. Carmine (four grms.) pulverized in 200 grms. water.

2. Ammonia added by drops until the solution becomes cherry-red (the carmine should now be fully dissolved).

[1] Kupffer. His and Braune. Archiv. Anat. Abth., 1882, p. 4.

3. Acetic acid slowly added until the cherry-red color becomes brick-red. The addition of acetic acid should be accompanied with stirring, and should cease the moment the change in color is effected.

4. Filter until no trace of a precipitate remains.

If the color is not sufficiently deep, a few drops of ammonia should be added before filtering, and the solution left in an open vessel until the alkali has volatilized.

Objects may be left for twenty-four hours or more in this fluid. The deep stain should be partially removed by immersion in a mixture of water (fifty vols.), glycerine (fifty vols.), and muriatic acid (a half vol.), for a few minutes. The karyokinetic figures are thus brought out with great distinctness.

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SCIENTIFIC NEWS.

— The Entomologische Nachrichten, founded by Dr. Katter at Putbus, is now edited by Dr. F. Karsch, and published by R. Friedländer & Sohn in Berlin. It is apparently improved, and No. 1 for this year is illustrated by a plate, with two wood-cuts. Dr. Ernest writes to it from Caracas, "we have here the locust plague! *Acridium peregrinum* in immense swarms. The eggs are infested by a small hymenopter, *Scelio famelicus* Say," noticed in the second report United States Entomological Commission, 270.

—A first duplicate of the "Philip Carpenter collection" of shells, reserved by the late Dr. Carpenter for private use and study, remains in possession of his widow, Mrs. Carpenter, 241 University street, Montreal. It contains, according to a catalogue accompanying it, 4039 species. There is also one of the best duplicates of the "Mazatlan collection" of Dr. Carpenter. These collections will be disposed of on reasonable terms, more especially to any public collection or working naturalist.

—*Nature* Nov. 20th, 1884, p. 72, contains a report of the Academy of Sciences, Paris, on the depth to which sunlight penetrates the waters of Lake Geneva, by MM. H. Fol and Ed. Tarasin. From a series of experiments carried out in August and September of that year, the author concludes that light reaches a depth of 170 meters, and probably a little more, the luminosity at this point being about equal to a clear moonless night.

— The first part of a detailed and well illustrated work on the embryology of Peripatus, by Dr. J. Kennel, appears in the Arbeiten aus dem Zoölogisch-Zoötomischen Institute in Würzburg. Bd. VII, Heft 2. The six folding plates are packed with illustrations which show, without undervaluing the labors of Balfour, that this memoir will be the fullest and most important yet published in the development of this exceedingly curious creature.

—Mr. A. Agassiz, the director of the Museum of Comparative Zoölogy, has distributed to correspondents in this country M.

Perrier's elaborate memoir on the star-fishes of the "Blake," dredged in the Antillean seas and Gulf of Mexico, under the direction of Mr. Agassiz. It appears in "Nouvelles Archives du Museum d' Histoire Naturelle, June 16, 1884.

For more than twenty-five years Professor J. V. Carus has been collecting materials for a general prodromus or preliminary view of the fauna of the Mediterranean sea. The first part has appeared, containing the Cœlenterates, Echinoderms and worms.

— Further experiments with the new anæsthetic, cocaine, have been made by M. Vulpian, and laid before the French Academy. Researches on snails and crawfishes show that it is less efficacious in the case of invertebrate then vertebrate animals.

— Of the Australian ants, *Formica rufinigra* is said to be the most numerous, bold, and destructive. It destroys the web of certain caterpillars, and wriggles them out, when they fall a prey to a host of attendant warrior ants.

— The death is reported of Mr. Alexander Murray, formerly director of the Geological Survey of Newfoundland, and author of a treatise on the geology of that island. His latest paper was a most interesting one on the glacial scratches of Newfoundland.

—Edward Rüppell died at Frankford, Dec. 10, at the age of 90 years. He was an explorer, geographer, and naturalist, his researches and travels having been made in Northeastern Africa and Arabia Petræa.

— We regret to be obliged to announce the sudden death, in January, by pneumonia, of Mr. Augustus Meisel, the well-known lithographer of Boston, who has produced most excellent zoölogical illustrations.

—M. Searles V. Wood, well known for his essays on English tertiary and quarternary deposits, died December last.

— The death is announced of Mr. Alfred Tylor, a well-known writer on geological and anthropological subjects.

— D. A. Keferstein, well known as a lepidopterist, died at Erfurt, Nov. 28.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Society of Naturalists of North America.—This body met at Washington, in the lecture room of the National Museum, on Jan. 29th. The following papers were read:

29th, A. M.

1. Charles S. Minot. A new cabinet for microscopical specimens.
2. ——A new feeding trough.
3. ——An apparatus for calculating intervals of days rapidly.
4. S. H. Gage. The use of Müller's fluid for preserving the dark colors of animals.
5. ——The use of collodion for protecting the rubber rings of museum jars.
6. ——Glass bulb canulæ for the injection of silver nitrate, gold chloride, etc.

7. H. F. Osborn. A simple method of injecting the entire arterial and nervous systems in different colors.
8. H. P. Bowditch. A new form of stop-cock for rubber-tubing.
9. R. Ramsay Wright. On methods of staining series of sections.
10. B. G. Wilder. The use of slips in scientific correspondence.
11. C. S. Minot. On a new staining solution for histological use.
12. C. A. Ashburner. Notes on barometric hypsometry.

29th, P. M.

1. H. C. Lewis. A summer school of geology.
2. C. A. Ashburner. Methods in practical geology.
3. H. N. Martin. The use of modeling clay to illustrate lectures.
4. H. F. Osborn. Methods of investigating the embryology of the opossum.
5. Theo. Gill. On osteological collections.

30th, A. M.

1. C. D. Walcott. The collecting and working of invertebrate palæontologic material.
2. G. K. Gilbert. Geological bibliography.
3. Geo. P. Merrill. Exhibition of a colored, enlarged photo-micrograph of a thin section of a rock.
4. G. Brown Goode. Account of the unit system of cases used in the U. S. National Museum.
5. J. A. Ryder. On museum alcoholics.
6. Wilder and Gage. An investigator's table with double or triple revolving top, and movable book-rests.
7. R. R. Wright. On the use of series of sections in laboratory teaching and a convenient method of obtaining them.

30th, P. M.

1. H. A. Howell. On the use of terrapin blood for the demonstration of the phenomena of coagulation.
2. Harrison Allen. Exhibition of the palatograph.
3. C. V. Riley. On the mounting of alcoholic specimens in insect cabinets.
4. ——On a preserving fluid for soft galls and plant tissues.
5. John Murdock. New application of the towing net in the Arctic regions.
6. F. W. True. On the preservation of type specimens.
7. G. B. Goode. The use of photography for making large diagrams.
8. W. H. Niles. Shall we define groups of organisms?
9. L. F. Ward. On a method of rapid drawing for photo-engraving.
10. R. E. Call. Dentition of certain mollusks.

BIOLOGICAL SOCIETY OF WASHINGTON.—The fifth anniversary meeting of the Society was held Jan. 24, 1885. The retiring president, Professor Charles A. White, delivered an address upon the application of biology to geological history.

NEW YORK ACADEMY OF SCIENCES, Jan. 12, 1885.—Mr. B. B. Chamberlain read notes on minerals from the French Creek mines, Chester county, Penna. (with exhibition of specimens).

Jan. 26, 1885.—The plan of the Mississippi River Commission and its relation to natural laws, was discussed by Mr. William L. Elseffer, C. E.

BOSTON SOCIETY OF NATURAL HISTORY, Jan. 7, 1885.—Professor W. O. Crosby read a paper on the color of soils.

Jan. 21.—Mr. Percival Lowell described the costume characteristics of the Coreans; and Professor Edw. S. Morse spoke of Corea as seen through interviews with a native Corean.

Appalachian Mountain Club, Jan. 8, 1885.—Mr. T. W. Bicknell described a summer trip to Alaska, with lantern slides, illustrating the topography of the Northern Pacific Railroad, Alaska, its products, mines, people, houses, dress, customs, social and religious, seals, glaciers and icebergs.

Jan. 14.—Annual meeting. The reports of the secretaries and the treasurer were presented, and the annual election of officers held. W. H. Pickering presented a paper, illustrated with the lantern, entitled an ascent of Vesuvius on the Pompeiian side.

American Geographical Society, Jan. 13, 1885.—Professor F. H. Cushing, of the Smithsonian Institution, who has dwelt for some years among the Zuñi Indians, delivered a lecture upon his explorations and researches on the discovery of Zuñi or the ancient province of Cibola and the seven lost cities, illustrated by ancient costumes, paraphernalia and stereopticon views.

Philadelphia Academy Natural Sciences, Nov. 13.—Dr. Randolph stated that he and Mr. S. G. Dixon had experimented on cutaneous absorption by placing one to fifteen drops of nicotine on the breasts of rabbits, taking care to previously remove the hair without abrading the skin. Death resulted in from halt an hour to four hours, and nicotine was found in the blood before death, proving that it was absorbed by the uninjured skin.

Nov. 20.—Dr. Leidy presented specimenns of *Urnatella gracilis*, showing that at the approach of winter the polyps die, the stalk alone remaining securely anchored and ready to reproduce in spring from the summit of the terminal joint. Mr. Potts stated that he had seen examples with seventeen joints, and that the number seemed to be limited only by the time of growth. The latter speaker also describes a rhizopod, apparently a new species of the genus *Acanthocystis*. It was collected on mica schist west of the Schuylkill. The protoplasm filled about one-third of the cavity of the capsule.

Professor Heilprin called attention to a boulder found at Summit, N. J., and containing *Atrypa reticularis*, a form of Strophomena, and several other species, proving that the material came from the Lower Helderberg, the nearest locality of which is sixty miles from where the boulder was found, while the nearest locality in the direction of the glacier's movement was at least a hundred miles.

Nov. 27.—Mr. Ford detailed the finding of *Pholas truncata*, Pierispata, and *Littorina irrorata* upon the beach at Atlantic City, also the discovery of capsules of *Fulgur carica* with living embryos. The Rev. Dr. McCook described a collection of the towers of turret spiders, some made with cotton and other materials supplied to them, others with their own materials. The work of individuals which have just emerged from the egg shows that at that age their instincts are perfectly developed.

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WHY CERTAIN KINDS OF TIMBER PREVAIL IN CERTAIN LOCALITIES.

BY JOHN T. CAMPBELL.

IT has often been observed that in certain localities a certain species of timber will prevail, or be more numerous than any, and sometimes than every other kind. It has been further observed that when any prevailing timber has been cleared away, and the land allowed to grow up again in timber, that some other species will prevail. This, I think, has often been erroneously attributed to the inability or indisposition of the soil to reproduce the former prevailing timber. I have observed much on this subject, and I never could see any important difference in the ability or disposition of the soil to nourish any of the different kinds of native trees, and also no important difference in the success in planting and starting them.

My observations convince me that it all, or mainly, lies in the favorable condition of the ground to receive the seeds of the various species of timber when it happens to fall thereon. A sycamore in the Wabash region will grow as large and rapidly on the uplands, where they are seldom found, as in the sandy bottoms along the margins of the streams, where they seem to best thrive. A white oak when planted will grow as well in the low river bottoms, where they are never or seldom found, as on the hills and ridges near by, where they seem to be the spontaneous product of the ground.

But if an acorn should be blown from a white oak on the hills into the low bottoms beneath, it would fall on ground very unfavorable to the sprouting of such acorns, and it would rot where it fell. So, on the other hand, if a sycamore ball (which contains

one thousand to two thousand seeds) should, in the spring time, be blown to pieces after the winter's freeze, and their needle-like seeds be blown upon the adjacent hills, very few of them would light on ground favorable to sprouting them. Occasionally we find a lone sycamore on the uplands, standing among the oak, beech, poplar and other upland timber, and every year bearing its quota of seed and shedding them on the adjacent ground by the million, none, or very few of which, ever take effect, and for reasons before hinted at, but which will be more fully explained further on.

The sycamore seed must fall on ground, warm, very moist, but not absolutely wet, and sufficiently bare for the sun to shine on it the greater part of the day. Otherwise it may not sprout. The acorn, on the other hand, falls a little while before the leaves fall. If it falls on very moist ground it rots. If it falls on the leaves of the former year, and is shaded enough to prevent drying or baking from the sun, and is covered lightly by the fall of the current year's leaves, or by a chance wind has the old leaves drifted on top of it, a slow rain with subsequent sunshine will sprout it. It will send out little rootlets which bore through the underlying old leaves and penetrate the ground, and once started, no weather or climatic conditions will kill it. The same is true of the seed of the hickory, beech, sugar maple and other upland trees.

During the past two years my work has been on and about the Wabash river banks and its bottoms (flood-plains), and I have discovered why it is that in some parts of these bottoms one kind of timber, as sycamore, will take complete possession of a few acres, while at or near by the cottonwood will prevail almost to the exclusion of everything else, and at other places the soft or water maple will do likewise, and at still another the water elm will monopolize all the space on which a grown tree can stand for several acres.

It comes about in this way. The balls of the sycamore, after undergoing the winter's freeze, are dissolved so that the separate, needle-like, or more properly pin-like seeds (as the outer end has the germ of the root, and swells into a bulb like a pin-head) are blown by the wind, the little "fuz" they hold enabling them to float a great way both in wind and on water. They begin falling early in the spring months, and if a flood is receding at the time, they stick to the soft, moist banks wherever they

touch them, and particularly along the highest part of the sand bars. Were it not for the subsequent floods the same spring, there could no other trees grow, as the sycamore, being the first to shed, would seed all the tree-growing space (each large tree bearing one hundred and fifty million seeds), and their broad leaves would shade the ground till nothing else could sprout. But during their early infancy they are easily killed by an overflow, and this ill fortune happens to the greater portion of them.

The cottonwood is the next in order of shedding seed. If another flood is receding while the cottonwood is shedding, this flood will have killed all the sycamores which it covered for only a few days, and will sprout all the cottonwood seed that may fall on and along the banks and bars. As the earlier floods are generally the highest there will be some sycamores not reached by the following floods, and they will hold sway along that margin. If, when the cottonwoods are a few inches high, another flood follows, they too will be killed to the extent that they are kept under water a few days.

Next to the cottonwood the soft, or bottom maple sheds its seed. If a flood is receding this seed will occupy all the space, as, having a smaller leaf than the sycamore or cottonwood, they will grow closer together. They in turn may be killed by a flood when they are very young.

I have forgotten the exact time that each of these trees sheds its seed, something will of course depend on the forwardness of the spring. But along the Wabash banks, last spring, I could see three belts of young trees, and distinguish them by their general appearance. The farther off, the plainer these belts show, till lost to view. The upper belt was sycamore, the second (downward) cottonwood, and the third soft maple. In June following there came a bigger flood than any that caused the seeds to sprout, and killed all of them. There was a much bigger flood in the preceding February, but no seed fell then.

It will sometimes happen that the flood that plants the sycamores will be the last one for that year, and when they have lived through one summer they are safe from any danger from overflow. In still other seasons it will happen to favor the cottonwood, or the maple, or elm, or willow. New bars are all the time extending from the lower ends of the old ones, and as the elevation of these will be such as to be sometimes flooded once and

not again for that year, the trees that shed their seed with the flood that barely covers such bars will plant them to overflowing fullness of their kind, and once they are secure from other floods they live out their time of two hundred to three hundred years.

The upper surface of the interior of the bottoms (back from the rivers) is built up by sedimentation, and when built above the height of the average floods, the burr oak, black walnut, buck-eye, pawpaw and bottom hickory make their appearance. Such sycamores, cottonwoods and maples as live long enough to be relegated to the interior (as very few of them do) by the bottoms building riverward away from them, do not and cannot reproduce themselves, as the conditions that sprout their seeds have moved away from them. They die at the end of three hundred years at most, and leave no heirs to the soil.

How do the occasional lone, stray sycamore and cottonwood find their way to the uplands? I can see how in one case it was not only possible but very probable. Five miles south-east of where I am now writing (Rockville, Indiana) is a pasture of hill land, so fenced as to include a section of a small stream at the foot of a hill facing north. There stand several half-grown sycamores which bear and shed their seed in this corner watering place. There these seeds are sprouted. There the cattle and horses resort for water. Every thimbleful of mud that may stick to their hoofs is liable to contain from one to five half-sprouted seeds, which are carried up the hillside and on the upland, as the cattle and horses return to their grass, and dropped where the sun takes up the unfinished work of growing the tree. The result is, that on every square rod of ground near this watering place stands one to five sycamores, varying in age from one to ten years, and they diminish in number as the distance from the watering place increases. It has been used as a pasture about ten years. I remember when it contained no sycamore at all. Just outside of the pasture fence, to the eastward, the land has never been fenced. The cows may drink where they please, and there are no sycamores scattered over the adjacent hills. If any seeds are thus carried there, the forest leaves and shade prevent their sprouting and growing. But along the little sand and gravel bars of the stream, they sprout as thick as grass, only to be killed by the floods from the early summer showers.

From this I infer that two hundred to three hundred years ago the deer, elk and buffalo in their many wanderings across streams and over hills, have occasionally carried in their hoofs partly sprouted seeds, and dropped them on the hills where the sunshine was unobstructed, and the trees thus got their footing, and once getting it were able to stand afterward. These are the only kinds of trees I have observed, but I presume a similar law governs the distribution and self-planting of them all.

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ON THE EVOLUTION OF THE VERTEBRATA, PROGRESSIVE AND RETROGRESSIVE.

BY E. D. COPE.

(Continued from page 247, March number.)

The Reptilian Line—Continued.

IN the first place, this line departs with lapse of time from the primitive and ancestral order, the Theromorpha, in two respects. First in the loss of the capitular articulation of the ribs, and second in the gradual elongation and final freedom of the suspensory bone of the lower jaw (the os quadratum). In so departing from the Theromorpha, it also departs from the mammalian type. The ribs assume the less perfect kind of attachment which the mammals only exhibit in some of the whales, and the articulation of the lower jaw loses in strength, while it gains in extensibility, as is seen in the development of the line of the eels among fishes. The end of this series, the snakes, must therefore be said to be the result of a process of creation by degeneration, and their lack of scapular arch and fore limb and usual lack of pelvic arch and hind limb are confirmatory evidence of the truth of this view of the case.

Secondly, as regards the ossification of the anterior part of the brain-case. This is deficient in some of the Theromorpa, the ancestral order, which resemble in this, as in many other things, the cotemporary Batrachia. Some of them, however (Diadectidæ), have the brain completely enclosed in front. The late orders mostly have the anterior walls membranous, but in the streptostylicate series at the end, the skull becomes entirely closed in front. In this respect then the snakes may be said to be the highest or most perfect order.

As regards the scapular arch, no order possesses as many ele-

ments as thoroughly articulated for the use of the anterior leg as the Permian Theromorpha. In all the orders there is loss of parts, excepting only in the Ornithosauria and the Lacertilia. In the former the adaptation is to flying. The latter retain nearly the Theromorph type. An especial side development is the modification of abdominal bones into two peculiar elements to be united with the scapular arch into a plastron, seen in the Testudinata. In this part of the skeleton the orders are generally degenerate, the last one, the Ophidia, especially so.

The pelvic arch has a more simple history. Again in the Theromorpha we have the nearest approach to the Mammalia. The only other order which displays similar characters is the Ornithosauria (Dimorphodon, according to Seeley). In the Dinosauria we have a side modification which is an adaptation to the erect or bipedal mode of progression, the inferior bones being thrown backwards so as to support the viscera in a more posterior position. This is an obvious necessity to a bipedal animal where the vertebral column is not perpendicular, as in birds. And it is from the Dinosauria that the birds are supposed to have arisen. The main line of the Reptilia, however, departs from both the mammalian and the avian type and loses in strength. In the latest orders, the Pythonomorpha and Ophidia, the pelvis is rudimental or absent.

As regards the limbs, the degeneracy is well marked. No reptilian order of later ages approaches so near to the Mammalia in these parts as do the Permian Theromorpha. This approximation is seen in the internal epicondylar foramen and well developed condyles of the humerus, and in the well differentiated seven bones of the tarsus. The epicondylar foramen is only retained in later reptiles in the Rhynchocephalian Hatteria (Dollo); and the condyles of the Dinosauria and all of the other orders, excepting the Ornithosauria and some Lacertilia, are greatly wanting in the strong characterization seen in the Theromorpha. The posterior foot seems to have stamped out the greater part of the tarsus in the huge Dinosauria, and it is reduced, though to a less degree, in all the other orders. In the paddled Sauropterygia, dwellers in the sea, the tarsus and carpus have lost all characterization, probably by a process of degeneracy, as in the mammalian whales. This is to be inferred from the comparatively late period of their appearance in time. The

still more unspecialized feet and limbs of the Ichthyosaurus (Ichthyopterygia) cannot yet be ascribed to degeneracy, for their history is too little known. At the end of the line the snakes present us with another evidence of degeneracy. But few have a pelvic arch (Stenostomidæ Peters), while very few (Peropoda) have any trace of a posterior limb.

The vertebræ are not introduced into the definitions of the orders, since they are not so exclusively distinctive as many other parts of the skeleton. They nevertheless must not be overlooked. As in the Batrachia the Permian orders show inferiority in the deficient ossification of the centrum. Many of the Theromorpha are notochordal, a character not found in any later order of reptiles excepting in a few Lacertilia (Gecconidæ). They thus differ from the Mammalia, whose characters are approached more nearly by some of the terrestrial Dinosauria in this respect. Leaving this order we soon reach the prevalent ball and socket type of the majority of Reptilia. This strong kind of articulation is a need which accompanies the more elongated column which itself results at first from the posterior direction of the ilium. In the order with the longest column, the Ophidia, a second articulation, the zygosphen, is introduced. The mechanical value of the later reptilian vertebral structure is obvious, and in this respect the class may be said to present a higher or more perfect condition than the Mammalia.

In review it may be said of the reptilian line, that it exhibits marked degeneracy in its skeletal structure since the Permian epoch; the exception to this statement being in the nature of the articulations of the vertebræ. And this specialization is an adaptation to one of the conditions of degeneracy, viz., the weakening and final loss of the limbs and the arches to which they are attached.

The history of the development of the brain in the Reptilia presents some interesting facts. In the Diadectid family of the Permian Theromorpha it is smaller than in a *Boa constrictor*, but larger than in some of the Jurassic Dinosauria. Marsh has shown that some of the latter possess brains of relatively very narrow hemispheres, so that in this organ those gigantic reptiles were degenerate, while the existing streptostylicate orders have advanced beyond their Permian ancestors.

There are many remarkable cases of what may now be safely

called degradation to be seen in the contents of the orders of reptiles.[1] Among tortoises may be cited the loss of the rib-heads and of one or two series of phalanges in the especially terrestrial family of the Testudinidæ. The cases among the Lacertilia are the most remarkable. The entire families of the Pygopodidæ, the Aniellidæ, the Anelytropidæ and the Dibamidæ are degraded from superior forms. In the Anguidæ, Teïdæ and Scincidæ we have series of forms whose steps are measured by the loss of a pair of limbs, or of from one to all the digits, and even to all the limbs. In some series the surangular bone is lost. In others the eye diminishes in size, loses its lids, loses the folds of the epidermis which distinguish the cornea, and finally is entirely obscured by the thickening of the cornea and closure of the ophthalmic orifice in the true skin. Among the snakes a similar degradation of the organs of sight has taken place in the order of the Scolecophidia, which live under ground, and often in ants' nests. The Tortricidæ and Uropeltidæ are burrowing snakes which display some of the earlier stages of this process. One genus of the true snakes even (according to Günther) has the eyes obscured as completely as those of the inferior types above named (genus Typhlogeophis).

VII. The Avian Line.

The palæontology of the birds not being well known, our conclusions respecting the character of their evolution must be very incomplete. A few lines of succession are, however, quite obvious, and some of them are clearly lines of progress, and others are lines of retrogression. The first bird we know at all completely, is the celebrated Archeopteryx of the Solenhofen slates of the Jurassic period. In its elongate series of caudal vertebræ and the persistent digits of the anterior limbs we have a clear indication of the process of change which has produced the true birds, and we can see that it involves a specialization of a very pronounced sort. The later forms described by Seeley and Marsh from the Cretaceous beds of England and North America, some of which have biconcave vertebræ, and all probably, the American forms certainly, possessed teeth. This latter character was evidently speedily lost, and others more characteristic of the subclass became the field of developmental change. The parts

[1] Such forms in the Lacertilia have been regarded as degradational by Lankester and Boulanger.

which subsequently attained especial development are the wings and their appendages; the feet and their envelopes, and the vocal organs. Taking all things into consideration the greatest sum of progress has been made by the perching birds, whose feet have become effective organs for grasping, whose vocal organs are most perfect and whose flight is generally good, and often very good. In these birds also the circulatory system is most modified, in the loss of one of the carotid arteries.

The power of flight, the especially avian character, has been developed most irregularly, as it appears in all the orders in especial cases. This is apparent so early as in the Cretaceous toothed birds already mentioned. According to Marsh the Hespeornithidæ have rudimental wings, while these organs are well developed in the Ichthyornithidæ. They are well developed among natatorial forms in the albatrosses and frigate pelicans, and in the skuas, gulls and terns; among rasorial types the sand-grouse, and among the adjacent forms, the pigeons. Then among the lower insessores, the humming-birds exceed all birds in their powers of flight, and the swifts and some of the Caprimulgidæ are highly developed in this respect. Among the higher or true song birds, the swallows form a notable example. With these high specializations occur some remarkable deficiencies. Such are the reduction of the feet in the Caprimulgidæ swifts and swallows, and the fœtal character of the bill in the same families. In the syndactyle families, represented by the kingfishers, the condition of the feet is evidently the result of a process of degeneration.

A great many significant points may be observed in the developmental history of the epidermic structures, especially in the feathers. The scale of change in this respect is in general a rising one, though various kinds of exceptions and variations occur. In the development of the rectrices (tail feathers) there are genera of the wading and rasorial types, and even in the insessorial series, where those feathers are greatly reduced or absolutely wanting. These are cases of degeneracy.

There is no doubt but that the avian series is in general an ascending one.

VIII. The Mammalian Line.

Discoveries in palæontology have so far invalidated the accepted definitions of the orders of this class that it is difficult to

give a clearly cut analysis, especially from the skeleton alone. The following scheme, therefore, while it expresses the natural groupings and affinities, is defective in that some of the definitions are not without exceptions :

I. A large coracoid bone articulating with the sternum.

Marsupial bones; fibula articulating with proximal end of astragalus

1. *Monotremata.*

II. Coracoid a small process coössified with the scapula.

α. Marsupial bones; palate with perforations (vagina double; placenta and corpus callosum rudimental or wanting; cerebral hemispheres small and smooth).

But one deciduous molar tooth.....2. *Marsupialia.*

αα. No marsupial bones; palate entire (one vagina; placenta and corpus callosum well developed).

β. Anterior limb reduced to more or less inflexible paddles, posterior limbs wanting (Mutilata).

No elbow joint; carpals discoid, and with the digits separated by cartilage; lower jaw without ascending ramus.....3. *Cetacea.*

An elbow joint; carpals and phalanges with normal articulations; lower jaw with ascending ramus .....4. *Sirenia.*

ββ. Anterior limbs with flexible joints and distinct digits; ungual phalanges not compressed, and acute at apex[1] (Ungulata[2]).

γ. Tarsal bones in linear series; carpals generally in linear series.

Limbs ambulatory; teeth with enamel.....5. *Taxeopoda.*[3]

γγ. Tarsal series alternating; carpal series linear.

Carpal series linear; no intermedium; fibula not interlocking with astragalus; no anapophyses; incisors rooted; hallux not opposable.....*Condylartha.*

Carpal series linear; an intermedium; fibula interlocking with astragalus; hallux not opposable .....*Hyracoidea.*

An intermedium; fibula not interlocking; anapophyses; hallux opposable; incisors growing from persistent pulps .....*Daubentonoidea.*

An intermedium; fibula not interlocking; anapophyses; hallux opposable; incisors rooted; carpus generally linear .....*Quadrumana.*

No intermedium;[4] nor anapophyses; carpal rows alternating; incisors rooted

Anthropoidea.

The only difference between the Taxeopoda and the Bunotheria is in the unguliform terminal phalanges of the former as compared with the clawed or unguiculate form in the latter. The marmosets among the former division are, however, furnished with typical claws.

Some may prefer to use the term Primates in place of Taxeopoda, and such may be the better course.

Cuboid bone partly supporting navicular, not in contact with astragalus

7. *Proboscidia.*

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[1] Except the Hapalidæ.

[2] Lamarck, Zoologie Philosophique, 1809.

[3] This order has the following suborders, whose association is now made for the first time.

[4] Except in Pithecus and Hylobates.

γγγγ. Both tarsal and carpal series more or less alternating.

Os magnum not supporting scaphoides; cuboid supporting astragalus; superior molars tritubercular.....8. *Amblypoda.*

Os magnum supporting scaphoides; superior molars quadritubercular 9. *Diplarthra.*[1]

ββ. Anterior limbs with flexible joints. Ungual phalanges compressed and pointed[2] (Unguiculata).

ε. Teeth without enamel; no incisors.

Limbs not volant; hemispheres small, smooth.....10. *Edentata.*

εε. Teeth with enamel; incisors present.

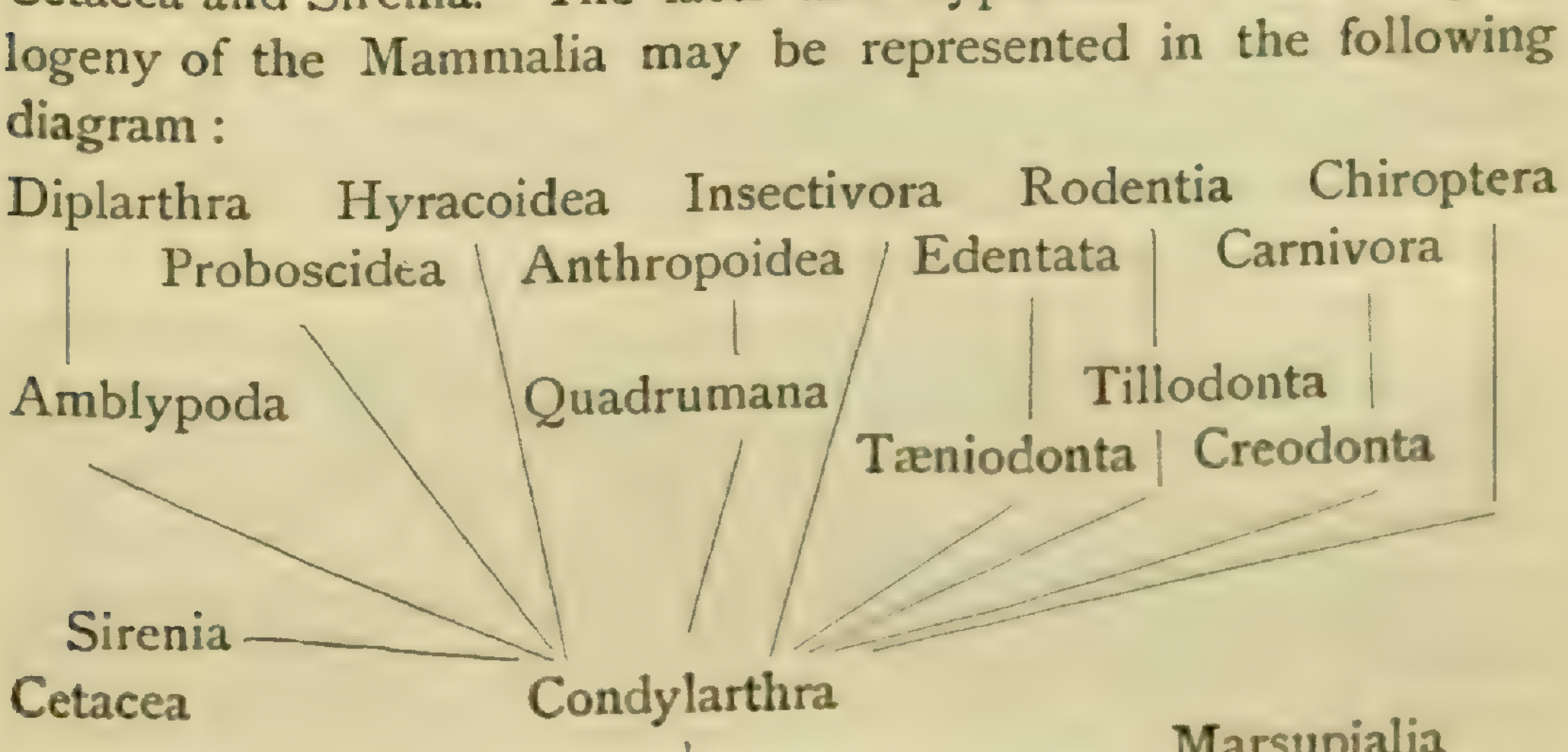
No postglenoid process; mandibular condyle round; limbs not volant; hemispheres small, smooth.....11. *Rodentia.*

Limbs volant; hemispheres small, smooth .....12. *Chiroptera.*

A postglenoid process; mandibular condyle transverse; limbs not volant, no scapholunar bone;[3] hemispheres small, smooth.....13. *Bunotheria.*[4]

A postglenoid process; limbs not volant, with a scapholunar bone; hemispheres larger, convoluted .....14. *Carnivora.*

Palæontology has cleared up the phylogeny of most of these orders, but some of them remain as yet unexplained. This is the case with the Cetacea, the Sirenia and the Taxeopoda. The last-named order and the Marsupialia can be supposed with much probability to have come off from the Monotremata, but there is as yet no palæontological evidence to sustain the hypothesis. No progress has been made in unraveling the phylogeny of the Cetacea and Sirenia. The facts and hypotheses as to the phylogeny of the Mammalia may be represented in the following diagram:



[1] Except Pantolestes. This order includes the suborders Perissodactyla and Artiodactyla.

[2] Except Mesonyx.

[3] Except Erinaceus.

[4] With the suborders Insectivora, Creodonta, Tæniodonta and Tillodonta.

It will be readily seen from the above diagram that the discovery of the Condylarthra was an important event in the history of our knowledge of this subject. This suborder of the Lower Eocene epoch stands to the placental Mammalia in the same relation as the Theromorphous order does to the reptilian orders. It generalizes the characteristics of them all, and is apparently the parent stock of all, excepting perhaps the Cetacea. The discovery of the extinct Bunotherian suborders united together inseparably the clawed orders, excepting the bats; while the extinct order Amblypoda is the ancestor of the most specialized of the Ungulates, the odd and even-toed Diplarthra.

The characters of the skeleton of the order Monotremata show that it is nearest of kin to the Reptilia, and many subordinate characters point to the Theromorpha as its ancestral source.[1] In the general characters the Marsupialia naturally follow in a rising scale, as proven by the increasing perfection of the reproductive system. The Monodelphia follow with improvements in the reproductive system and the brain, as indicated in the table already given. The oldest Monodelphia were, in respect to the structure of the brain, much like the Marsupialia, and some of the existing orders resemble them in some parts of their brain-structure. Such are the Condylarthra and Amblypoda of extinct groups, and the Bunotheria, Edentata, Rodentia and Chiroptera, recent and extinct. The characters of the brains of Amblypoda and some Creodonta are, in their superficial characters, even inferior to existing marsupials. The divided uterus of these recent forms also gives them the position next to the Marsupialia. In the Carnivora, Hyracoidea and Proboscidia a decided advance in both brain structure and reproductive system is evident. The hemispheres increase in size and they become convoluted. A uterus is formed and the testes become external, etc. In the Quadrumana the culmination in these parts of the structure is reached, excepting only that in the lack of separation of the genital and urinary efferent ducts, the males are inferior to those of many of the Artiodactyla. This history displays a rising scale for the Mammalia.

Looking at the skeleton we observe the following successional modifications :[2]

[1] Proceedings American Philosoph. Society, 1884, p. 43.

[2] See the evidence for evolution in the history of the extinct Mammalia. Proceeds. Amer. Assoc. Adv. Science, 1883.

First, as to the feet, and (A) the digits. The Condylarthra have five digits on both feet, and they are plantigrade. This character is retained in their descendants of the lines of Anthropoidea, Quadrumana and Hyracoidea, also in the Bunotheria, Edentata and most of the Rodentia. In the Amblypoda and Proboscidia the palm and heel are a little raised. In the Carnivora and Diplarthra the heel is raised, often very high, above the ground, and the number of toes is diminished, as is well known, to two in the Artiodactyla and one in the Perissodactyla. (B) The tarsus and carpus. In the Condylarthra the bones of the two series in the carpus and tarsus are opposite each other, so as to form continuous and separate longitudinal series of bones. This continues to be the case in the Hyracoidea and many of the Quadrumana, but in the anthropoid apes and man the second row is displaced inwards so as to alternate with a first row, thus interrupting the series in the longitudinal direction, and forming a stronger structure than that of the Condylartha. In the Bunotherian rodent and edentate series, the tarsus continues to be without alternation, as in the Condylarthra, and is generally identical in the Carnivora. In the hoofed series proper it undergoes change. In the Proboscidia the carpus continues linear, while the tarsus alternates. In the Amblypoda the tarsus alternates in another fashion, and the carpal bones are on the inner side linear, and on the outer side alternating. The complete interlocking by universal alternation of the two carpal series is only found in the Diplarthra. (C) As to the ankle-joint. In most of the Condylarthra it is a flat joint or not tongued or grooved. In most of the Carnivora, in a few Rodentia, and in all Diplarthra, it is deeply tongued and grooved, forming a more perfect and stronger joint than in the other orders, where the surfaces of the tibia and astragalus are flat. (D) In the highest forms of the Rodentia and Diplartha the fibula and ulna become more or less coössified with the tibia and radius, and their middle portions become alternated or disappear.

Secondly, as regards the vertebræ. The mutual articulations (zygapophyses) in the Condylartha are flat and nearly horizontal. In higher forms, especially of the ungulate series, they become curved, the posterior turning upwards and outwards, and the anterior embracing them on the external side. In the higher Diplartha this curvature is followed by another curvature of the

postzygapophysis upwards and outwards, so that the vertical section of the face of this process is an S. Thus is formed a very close and secure joint, such as is nowhere seen in any other Vertebrata.

Thirdly, as regards the dentition. Of the two types of Monotremata, the Tachyglossidæ and the Platypodidæ, the known genera of the former possess no teeth, and the known genus of the latter possesses only a single corneous epidermic grinder in each jaw. As the Theromorphous reptiles from which these are descended have well developed teeth, their condition is evidently one of degeneration, and we can look for well toothed forms of Monotremata in the beds of the Triassic and Jurassic periods. Perhaps some such are already known from jaws and teeth. In the marsupial order we have a great range of dental structure, which almost epitomizes that of the Monodelph orders. The dentition of the carnivorous forms is creodont; of the kangaroos is perissodactyle, and that of the wombats is rodent. Other forms repeat the Insectivora. I therefore consider the placental series especially. I have already shown that the greater number of the types of this series have derived the characters of their molar teeth from the stages of the following succession. First a simple cone or reptilian crown, alternating with that of the other jaw. Second, a cone with lateral denticles. Third, the denticles to the inner side of the crown forming a three-sided prism, with tritubercular apex, which alternates with that of the opposite jaw. Fourth, development of a heel projecting from the posterior base of the lower jaw, which meets the crown of the superior, forming a tubercular-sectorial inferior molar. From this stage the carnivorous and sectorial dentition is derived, the tritubercular type being retained. Fifth, the development of a posterior inner cusp of the superior molar and the elevation of the heel of the inferior molar, with the loss of the anterior inner cusp. Thus the molars become quadritubercular, and opposite. This is the type of many of the Taxeopoda, including the Quadrumana and Insectivora as well as the inferior Diplarthra. The higher Taxeopoda (Hyracoidea) and Diplarthra add various complexities. Thus the tubercles become flattened and then concave, so as to form Vs in the section produced by wearing, or they are joined by cross-folds, forming various patterns. In the Proboscidia they become multiplied so as to produce numerous cross-crests.

The dentition of some of the Sirenia is like that of some of the Ungulata, especially of the suilline group, while in others the teeth consist of cylinders. In the Cetacea the molars of the oldest (Eocene and Miocene) types are but two-rooted and compressed, having much the form of the premolars of other Mammalia. In existing forms a few have simple conical teeth, while in a considerable number teeth are entirely wanting.

A review of the characters of the existing Mammalia as compared with those of their extinct ancestors displays a great deal of improvement in many ways, and but few instances of retrogression. The succession in time of the Monotremata, the Marsupialia, and the Monodelphia, is a succession of advance in all the characters of the soft parts and the skeleton which define them (see table of classification). As to the monotremes themselves, it is more than probable that the order has degenerated in some respects in producing the existing types. The history of the Marsupialia is not made out, but the earliest forms of which we know the skeleton, Polymastodon (Cope) of the Lower Eocene, is as specialized as the most specialized recent forms. The dentition of the Jurassic forms, Plagiaulax, etc., is quite specialized also, but not more so than that of the kangaroos. The premolars are more specialized, the true molars less specialized than in those animals.

Coming to the Monodelphia the increase in the size and complication of the brain, both of the cerebellum and the hemispheres, is a remarkable evidence of advance. But one retrogressive line in this respect is known, viz., that of the order Amblypoda,[1] where the brain has become relatively smaller with the passage of time. The successive changes in the structure of the feet are all in one direction, viz., in the reduction of the number of the toes, the elevation of the heel and the creation of tongue and groove joints where plain surfaces has previously existed. The diminution in the number of toes might be regarded as a degeneracy, but the loss is accompanied by a proportional gain in the size of the toes that remain. In every respect the progressive change in the feet is an advance. In the carpus and tarsus we have a gradual rotation of the second row of bones on the first, to the inner side. In the highest and latest orders this process is most complete, and as it results in a more

[1] See NATURALIST, Jan., 1885, p. 55.

perfect mechanical arrangement, the change is clearly an advance. The same progressive improvement is seen in the development of distinct facets in the cubito-carpal articulation, and of a tongue and groove ("intertrochlear crest") in the elbow-joint. In the vertebræ the development of the interlocking zygapophysial articulations is a clear advance.

Progress is generally noticeable in the dental structures; unlike the marsupial line the earliest dentitions are the most simple, and the later the more complex. Some of the types retain the primitive tritubercular molars, as the Centetidæ, shrews and some lemurs, and many Carnivora, but the quadritubercular and its derivative forms is by far the most common type in the recent fauna. The forms that produced the complicated modifications in the Proboscidia and Diplarthra appeared latest in time, and the most complex genera, Bos and Equus, the latest of all. The extreme sectorial modifications of the tritubercular type, as seen in the Hyænidæ and the Felidæ, are the latest of their line also.

Some cases of degeneracy are, however, apparent in the monodelphous Mammalia. The loss of pelvis and posterior limbs in the two mutilate orders is clearly a degenerate character, since there can be no doubt but that they have descended from forms with those parts of the skeleton present. The reduction of flexibility seen in the limbs of the Sirenia and the loss of this character in the fore limbs of the Cetacea are features of degeneracy for the same reason. The teeth in both orders have undergone degenerate evolution, to extinction in the later and existing forms of the Cetacea. The Edentata appears to have undergone degeneration. This is chiefly apparent in the teeth which are deprived of enamel, and which are wanting from the premaxillary bone. A suborder of the Bunotheria, the Tæniodonta of the Lower Eocene period, display a great reduction of enamel on the molar teeth, so that in much worn examples it appears to be wanting. Its place is taken by an extensive coat of cementum, as is seen in Edentata, and the teeth are ever rootless as in that order. It is probable that the Edentata are the descendants of the Tæniodonta by a process of degeneracy.

Local or sporadic cases of degenerate loss of parts are seen in various parts of the mammalian series, such are toothless Mammalia wherever they occur. Such are cases where the teeth become extremely simple, as in the honey-eating marsupial Tarsipes,

the carnivore Proteles, the Pteropod bats, and the aye-aye. Also where teeth are lost from the series, as in the canine genus Dysodus, and in man. The loss of the hallux and pollex without corresponding gain, in various genera, may be regarded in the same light.

In conclusion, the progressive may be compared with the retrogressive evolution of the Vertebrata, as follows: In the earlier periods and with the lower forms, retrogressive evolution predominated. In the higher classes progressive evolution has predominated. When we consider the history of the first class of vertebrates, the Tunicata, in this respect, and compare it with that of the last class, the Mammalia, the contrast is very great.

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PROGRESS OF NORTH AMERICAN INVERTEBRATE PALÆONTOLOGY FOR 1884.

BY J. B. MARCOU.

THE year that has just passed has been fairly prolific in palæontological work, about fifteen more titles appearing in this review than there were in the last; it is true that a few of them should have been inserted last year, but doubtless some titles have escaped me also this year, and the two errors may be considered to compensate each other; so that we have an increase of about one-third in the number of articles published. There is also a general improvement in the quality of illustrations, though of course there is still plenty of room for improvement, and it is surprising that some palæontologists should persist in publishing a large number of descriptions with no illustrations at all, or with such imperfect illustrations as to render them practically useless; the chief result brought about by such publication of species is an increase of our already voluminous synonymy. The day will doubtless come when descriptions of new species unaccompanied by proper diagnoses and illustrations will no longer be recognized, for it is next to impossible to recognize a form from a meager description unaccompanied by an illustration. The founding of new genera and species on very imperfect specimens is also a very reprehensible practice, for although it may be excellent exercise for the imagination of the author, yet it may introduce errors which it will take a great deal of time and trouble to eradicate, especially when there is no indication that such descriptions

and figures are restored according to the idea that the author had of the way in which they ought to be.

This year we have the first volume of the Transactions of the Royal Society of Canada. The committe on publication cannot be too severely criticised for having printed a large quarto of about 700 pages, containing many interesting papers, without any index, and for using five different systems of pagination, as well as varying the system of headings for each page.

H. M. Ami has notes on *Triarthus spinosus* in the Trans. Ottawa Field Nat. Club.

Chas. E. Beecher, in Report. P.P.P. 2d Geol. Surv. Penna., has an excellent article on the "Ceratiocaridæ from the Chemung and Waverley groups at Warren, Pennsylvania."

W. B. Billings has "Notes on, and description of some fossils from the Trenton limestone," in the Trans. Ottawa Field Nat. Club.

E. J. Chapman publishes, in the Trans. Roy. Soc. Canada, a "Classification of Crinoids" based on the presence or absence of a canaliculated structure in the calyx and arm plates.

E. W. Claypole has an article "On the occurrence of the genus Dalmanites in the Lower Carboniferous rocks of Ohio," in the *Geological Magazine* for July; also a Preliminary note on some fossil Fishes recently discovered in the Silurian rocks of North America, in the AMERICAN NATURALIST for December.

William B. Dwight, in the *Amer. Journ. of Science and Arts* for April, has his fourth article on "Recent explorations in the Wappinger Valley limestone of Dutchess county, New York, No. 4, Descriptions of Calciferous ? fossils."

Aug. F. Foerste, in the AMERICAN NATURALIST for January, has a note on "The power of motion in Crinoid stems."

W. M. Fontaine, in the monographs of the U. S. Geol. Survey, has published his "Contributions to the knowledge of the older Mesozoic flora of Virginia." This work is divided into three parts; in the first the author gives a brief description of the geology of the Virginia Mesozoic areas. In the second he describes the flora and compares it with plants from the Triassic, Jurassic and Rhætic of other regions. In the third he republishes Emmons' figures of the Mesozoic flora of N. Carolina, compares it with the Virginia flora, considers both floras as of the same age, and that age as not older than the rhætic.

S. W. Ford, in the *Amer. Journ. Sci. and Arts* for July, has a "Note on the discovery of Primordial fossils in the town of Stuyvesant, Columbia county, N. York."

James Hall has published another abstract of a paper to be issued in the 35th museum report of the State of N. Y., containing descriptions of the species of fossil reticulate sponges, constituting the family Dictyospongidæ; the plates were published before with the title, "Notes on the family Dictyospongiæ." An abstract of this article appeared in the *Geological Magazine* for December. The same number of the *Geological Magazine* contains an abstract of a paper "On the Lamellibranchiate fauna of the Upper Helderberg, Hamilton, Portage, Chemung and Catskill groups (equivalent to the Lower, Middle and Upper Devonian of Europe); with especial reference to the arrangement of the Monomyaria and the development and distribution of the species of the genus Leptodesma."

G. Hambach, in the Trans. Acad. Sci. St. Louis, Vol. IV, No. 3, has "Notes about the structure and classification of the Pentremites. In the same volume he has also an article describing some "New Palæozoic Echinodermata."

Angelo Heilprin has published "North American Tertiary Ostreidæ" as an appendix to Dr. White's review of the fossil Ostreidæ. He describes a Carboniferous Ammonite from Texas in the Proc. Acad. Nat. Sci. Philadelphia. He has also published a collection of his works on the Tertiary, under the title "Contributions to the Tertiary geology and palæontology of the United States."

Alpheus Hyatt, in *Science*, Vol. III, has an article on the "Evolution of the Cephalopoda." In the AMER. NATURALIST for September he has a note on the "Protoconch of Cephalopoda." In the Proc. Boston Soc. Nat. Hist. he places a paper, preliminary to a monograph which will appear in the memoirs of the Museum of Comp. Zoology, on the "Genera of fossil Cephalopods." In the Proc. of the Amer. Assoc. for the Adv. of Sci., August, 1883, he has a paper on the "Fossil Cephalopoda in the Museum of Comparative Zoology," containing a discussion of the relations of this group.

J. F. James, in *Science*, Vol. III, criticises two of the determinations made by Leo Lesquereux in his Tertiary flora U. S. Geol. and Geog. Surv. Terr., F. V. Hayden. [This work although printed has not yet been distributed.] He also has an article on

"The Fucoids of the Cincinnati group," in the Journ. Cincinnati Soc. Nat. Hist., Vol. VII.

U. P. James, in the Journ. Cincinnati Soc. Nat. Hist., Vol. VII, publishes three articles; in the April number he describes three fossils from the Cincinnati group. In the October number he describes four new species of fossils from the Cincinnati group; and in the same number he has also an article "On Conodonts and fossil annelid jaws."

T. R. Jones and J. W. Kirby, in the *Geological Magazine* for August, have descriptions and notes "On some Carboniferous Entomostraca from Nova Scotia."

Leo Lesquereux, in the 2d Geol. Surv. Pennsylvania, Rep. Progress P., Vol. III, finishes his description of the coal flora of the Carboniferous formation in Pennsylvania and throughout the United States. This contains also additions and corrections to the first two parts previously published.

In the 13th annual report of the Indiana Department of Geology and Natural History, the same author publishes "Principles of Palæozoic Botany," an excellent elementary treatise. The Indiana Geol. Surv. has done excellent work in the way of popular instruction, and it is to be hoped that its labors will not be permanently discontinued. In the AMERICAN NATURALIST for September the author has an article on "The Carboniferous flora of Rhode Island."

J. B. Marcou, in the AMERICAN NATURALIST for April, published a review of the progress of North American invertebrate palæontology for 1883.

G. F. Matthew has two short abstracts of articles in the *Geological Magazine* for October: "The primitive Conocoryphean," and "The geological age of the Acadian fauna." In the Trans. Royal Soc. of Canada, Vol. I, the same author has "Illustrations of the fauna of the St. John group, No. I, The Paradoxides," and a supplementary section describing the parts of the previously described species.

John Mickleborough, in the *Geological Magazine* for February, republishes his article on the "Locomotory appendages of Trilobites" (see last year's review).

S. A. Miller published a "Description of a beautiful star-fish and other fossils" from the Cincinnati group in the April number of the Journ. Cincinnati Soc. Nat. Hist.

Otto Myer, in the Proc. Acad. Nat. Sci., Philadelphia, published "Notes on Tertiary shells." In these notes he proposes the n. g. Tibiella, but gives no synopsis of generic characters.

M. Neumayr, in the Neu. Jahrb. für Min., Geol. und Pal., Stuttgart, notes the parallel position occupied by the Laramie group in N. W. America, and the Intertrappean beds of the Deçcan in Hindostan.

E. N. S. Ringueberg, in the Proc. Acad. Nat. Sci. Philadelphia, has descriptions of "New fossils from the four groups of the Niagara period of Western New York."

S. H. Scudder, in the *Amer. Journ. Sci. and Arts* for September, has an article on Triassic insects from the Rocky mountains. Mr. Scudder identifies these beds as belonging to the Triassic period, according to their insect fauna. Mr. Lesquereux considers that their flora shows them to be of Permian age. In the Mem. Boston Soc. Nat. Hist., Vol. III, he has an article on "Two new and diverse types of Carboniferous myriapods," and in the same publication he has also "The species of Mylacris, a Carboniferous genus of cockroaches." In the Proc. Amer. Acad. Arts and Sci. Boston, the same author has two articles, one "A contribution to our knowledge of Palæozoic Arachnida;" the other on "Dictyoneura and the allied insects of the Carboniferous epoch." This last is a brief paper published in advance of a fuller memoir with detailed descriptions and full illustrations.

J. W. Spencer, in the Bull. Museum of the University of the State of Missouri, publishes an article on "Niagara fossils," which will be reproduced also in the Proc. St. Louis Acad. Sci., Vol. IV, No. 4. The illustrations are so bad and the species in some instances, *e. g.*, *Cyrtoceras reversum*, founded apparently on such poor specimens that it will be very difficult if not impossible for future workers to recognize Mr. Spencer's types.

Frank Springer, in the *Amer. Journ. Sci. and Arts* for February, has an article "On the occurrence of the Lower Burlington limestone in New Mexico.

E. O. Ulrich, in the Journ. Cincinnati Soc. Nat. Hist., December, 1883, continues his descriptions of N. American Palæozoic Bryozoa.

C. D. Walcott has published his "Palæontology of the Eureka district," being Vol. VIII of the monographs of the U. S. Geological Survey. The discussion of the development of *Olenellus*

howelli is very interesting. The discovery in the Devonian of the interior of a dorsal valve of *Lingula whitei* proves the great similarity of structure between the Lingulæ of the Silurian, Devonian and recent time. A commingling of Upper Devonian and Lower Carboniferous fossils occurs; there occurs also a gradual transition from the beds containing *Olenellus howelli* through beds containing a fauna similar to the Potsdam of New York, to beds containing a fauna comparable to that of the chazy and calciferous groups. The transition is very gradual, and such as would occur where there had been no marked physical disturbance. In the Bull. U. S. Geological Survey the same author has "Preliminary studies on the Cambrian faunas of N. America." These are in three parts, the first is "A review of the fauna of the St. John formation, contained in the Hartt collection." This work is not meant to encroach on that of Mr. Matthew. Mr. Walcott does not accept the genus Conocephalites, and refers its different species to Ptychoparia and one of Conocoryphe. The second part is on the "Fauna of the Braintree Argillites." The third part contains the description of a new genus and species of Phyllopoda from the Middle Cambrian slates of Parker's farm, Georgia, Vermont. In *Science*, Vol. III, the same author has an article on the "Appendages of the Trilobite;" he notes the verification of the hypothesis that the legs were jointed beneath the pygidium as the only addition to our knowledge furnished by Mr. Mickleborough's specimen.

Lester F. Ward, in the *Amer. Jour. of Sci. and Arts*, has an article "On Mesozoic Dicotyledons."

C. A. White, in the Rep. of the Secretary of the Interior for 1883, Vol. III, gives "A review of the fossil Ostreidæ, North America, and a comparison of the fossil with the living forms. With appendices by Professor Angelo Heilprin and Mr. John A. Ryder." This work is on the same plan as that followed in the review of the non-marine fossil Mollusca published the year previous. In the Bull. of the U. S. Geological Survey, No. 4, the author has three articles, the first, "On a small collection of Mesozoic fossils collected in Alaska, by Mr. W. H. Dall, of the U. S. Coast Survey." The author considers these forms to belong to beds occupying a transitional position between Cretaceous and Jurassic, as previously suggested by Professor J. Marcou. The second is a "Description of certain aberrant forms of the Chami-

dæ from the Cretaceous rocks of Texas." And the third is "On the nautiloid genus Enclimatoceras Hyatt, and a description of the type species." In Vol. VI of the Proc. of the U. S. National Museum he has an article "On the Macrocheilus of Phillips, Plectostylus of Conrad, and Soleniscus of Meek and Worthen. In *Science*, Vol. III, he has a note on the "Enemies and parasites of the oyster, past and present." In the 13th annual report of the Indiana Department of Geol. and Nat. Hist., the same author has "The fossils of the Indiana rocks, No. 3." In this work he gives excellent illustrated descriptions of the characteristic invertebrate animal remains of the Carboniferous period.

J. F. Whiteaves, in the Geol. and Nat. Hist. Surv. of Canada, has Part III of his Mesozoic fossils, "On the fossils of the coal-bearing deposits of the Queen Charlotte islands collected by Dr. G. M. Dawson in 1878. The author is driven by his conclusions to assert that the Jurassic of the Black hills and Rocky mountains is Cretaceous. This assertion is far from being justified by the facts which the author adduces for its support. He has also Part I of Vol. III of "Paleozoic fossils." In the Trans. Royal Soc. Canada, he has an article on the "Lower Cretaceous rocks of British Columbia." In this article he holds that the presence of an abundance of Ancellæ is a sure proof of the Neocomian age of the rocks in which they occur. In the same publication he has also an article "On some supposed Annelid tracts from the Gaspé sandstones."

R. P. Whitfield, in the Bull. Amer. Museum Nat. Hist. Vol. I, No. 5, has a "Notice of some new species of primordial fossils in the collections of the museum, and corrections of previously described species." He thinks that the difference in faunas between the different Cambrian areas is more the result of the conditions upon which life depended than a difference in time.

H. S. Williams, in the Bull. U. S. Geol. Surv., Vol. No. 3, has an article "On the fossil faunas of the Upper Devonian along the meridian 76° 30′ from Tompkins county, New York, to Bradford county, Pennsylvania." The paper is the first of a series. In *Science*, Vol. III, he has an article on "The Spirifers of the Upper Devonian."

H. Woodward, in the *Geological Magazine* for February and for April, has two articles, one is "On the structure of Trilobites." This is a reproduction of the author's views on the ap-

pendages of trilobites; and in particular of *Asaphus platycephalus* Stokes, as published by him in 1871. The other bears the title, "Notes on the appendages of Trilobites. Note to accompany three woodcuts of *Asaphus megistos*, a trilobite discovered by Mr. James Pugh, near Oxford, Ohio, in the upper portion of the Hudson River group." The figures are a reproduction of Mr. Mickleborough's.

A. H. Worthen, in Bull. No. 2 of the Illinois State Museum Nat. Hist., publishes descriptions of two new species of Crustacea, fifty-one species of Mollusca and three species of Crinoids from the Carboniferous formation of Illinois and adjacent States. No illustrations whatever accompany these numerous descriptions.

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THE CLAM-WORM.

BY SAMUEL LOCKWOOD, PH.D.

WALKING at low tide on the wet flats of the New Jersey shore, the stranger is surprised by little spurts of water suddenly springing from the sand. These jets reveal the hiding places of the soft clam, or "nanny nose," a corruption of the Indian name "maninose." This discharge of water at the approach of footsteps, thus betraying its retreat, is an act which the mollusk cannot help. The home of the bivalve is often many inches deep in the sand, but the extensile siphon must reach the surface. Alarmed at the tremor of the sand caused by the approaching steps, this organ is so rapidly withdrawn, even down into the valves at the bottom of the perpendicular burrow, that the sudden collapse expels the water with which the siphon and other cavities of the body are filled. Without such result the rapid retreat of the siphon from harm's way would be impossible. After one of these squirts I have dug fully fourteen inches deep, and found the clam with all its parts snugly tucked within its two valves.

The water ejected as described is simply the fluid which was taken in before the tide went out. If the observer will be quiet and keep motionless for a few minutes the clam may soon regain its confidence, and the tip of the siphon, with its two pretty orifices—the inlet and the outlet, again appear at the little hole in the sand. Now let one's foot be moved, and again the siphon is

instantly withdrawn; but there is no spurt as before, because the previous effort had emptied it of water.

The systematists call our mollusk *Mya arenaria*, but in popular speech, because of its siphon, it is sometimes known as the stem-clam, and to distinguish it from *Venus mercenaria*, the quahog, round-clam or hard-clam, it is often called the soft-clam and long-clam.

Busily delving with short-handled hoes, men and boys may be seen, at low tide, all over these sandy flats. They are "the clammers." Long practice, with perhaps inherited instinct, has made these persons expert in detecting the signs of the places of these mollusks, even when not betrayed in the usual way. They certainly have that fine eye for discernment which comes of being to the business "bred and born." Though perhaps preferring such places, these soft-clams are not limited to the sandy flats. They are also found in gravelly and even muddy beds.

In digging the clammer brings to the surface many a fine invertebrate of much interest to the naturalist. Among these quite often is a gayly tinted annelid, a quasi-aquatic myriopod. We watched one of these delvers, a youth quite bright in his own way, and respectful too, except perhaps to some student pedant whom he cannot understand, and whom he seems to regard as a "dude in larning," as we found out a little to our cost. There! He turns up an annelid now, and we exclaim—"What a pretty Nereid!" To which, with a quizzical cast of the eyes, he responds: "Nary time, Mister! That's only a clam-worrum!" Glad to become a learner upon opportunity, we ask why it is called a clam-worm. The answer, now politely given, is: "Because its gin'ally found along with the clam. Most like it's clam-feed, or something in that way."

The best known of these Nereids in our Eastern waters are *N. limbata*, *N. virens* and *N. pelagica*; of these three the chances are many that the Jersey clammers' acquaintance will be restricted to the first one mentioned, though all would be the same to him. And it must be known that though called a clam-worm, Nereis is no pariah, but the very highest in its class, the Annelides. And *N. limbata* is sometimes found seeking the higher society of the marine invertebrates. Verrill says of this species: "Both males and females were often found among the barnacles and ascidians on the piles of the wharves at Wood's Holl, but the males were

the most abundant, while the reverse was the case with those dug out of the sand and gravel at the shores." The same author tells of their habitats in shelly and gravelly beds, and even of their floating in great numbers at the surface of the water. This statement recalls a thrilling experience of our own many years ago inside of Sandy Hook. All told we numbered three, in a sail-boat, and our one object, squidding for blue-fish, the gamey *Pomatomus saltatrix*. The wind was so stiff that we had enough on our hands to take care of ourselves and our little craft. It was a very warm day in August, and to my astonishment we went through a floating bank of these clam-worms, They lay close together, and the float seemed several hundred feet long, and owing to the high wind it was disposed in concentric drifts, or wind-rows. Our game was up, touch our squids Pomatomus would not—he had come to a banquet worthy of the gods—I cannot affirm whether the banquet had attracted them, but just after the Nereid course was finished, a school of Menhaden appeared. The blue-fish went for them, and the scene was simply pitiful. In their frantic efforts to escape, the poor things piled themselves one upon another, and the jaws of the terrible blue-fish, like a thousand shears, cut into them, while the air was alive with gulls screaming in delight over the carnage, as they were continually pouncing upon the floating fragments of the gory feast. As the Nereids deposit their eggs near shore, and as this scene was witnessed inside of Sandy Hook bay, a good place for their breeding, and as my memory serves, the worms were small, it has seemed to me that they were young individuals.

Wishing to resume study of the Actiniæ, I procured from Fall river some specimens of *Metridium marginatum*, with a quantity of the green sea-lettuce, *Ulva latissima*, among which was one tuft of the succulent red alga, *Rhabdonia tenera*. The plants soon took on a fine growth. I became annoyed, however, at the unsightly appearance of ragged holes in the green fronds, and their number steadily increasing. Soon the depredator was detected at work in a thick bunch of Ulva. The red alga was not touched. This annelid browsing was an interesting sight. For every one of its many segments was a pair of parapoda, or side paddles, with which, though the action seemed serpentine, it moved about a plant as easily as a bird around an evergreen when seeking insects on the tree. And what a pair of jaws, each

with a row of small sharp teeth on the curve of the inner side, as if two tiny sickles could be converted into saws. The little beast was slashing remorselessly into these translucent delicate sheets of emerald gelatine. I said jaws. The whole apparatus has been called a proboscis—but such an exceptional one! The annelid in repose carries his jaws down his throat just over the œsophagus, and when he eats the two serrate sickle jaws are everted, that is, protruded, pharynx and all. This creature was our clam-worm, *Nereis limbata.* It moves in graceful ease through the marine meadows by means of its two long rows of parapoda, or natural oars. It has four eyes, and they see me too, for it disappears instantly. Its retreat is a little burrow in the sand, a transverse section of which would be nearly oval. The books say that the Nereis secretes a viscid fluid with which it lines its burrow. Its progress in this retreat is rapid, and it can move either way with equal ease. Its head is now at the entrance, hence it has turned in its burrow, and as this is pretty well filled by the worm's body, how does it double on itself? It has such a knowing look with its four optics, and four pairs of feelers, as if in its tentacular wisdom it were inspecting every object anent the cabin door. And then it has an amiable look, for that proboscis with its formidable jaws is concealed down the throat.

I found two others in the tank. Each was from two and a half to three inches long. Twice one of them was so accommodating as to make its burrow against the glass side of the tank. I now watched the movement in the burrow and saw how easily it could advance or recede; but I failed to see the doubling on itself. And then it was pretty to note that the paddle-like rami were never soiled.

How could I grudge my Nereids their inroads on the lettuce beds, as I deemed them vegetarians of the Simon-pure variety? I was feeding the Actiniæ with small pellets of raw beef. It occurred to me to tempt the Nereid from its simple fare with a stronger diet; so I dropped a bit of beef at the entrance to the burrow. The tentacular wisdom made a snap judgment—"fresh beef is good," for out popped the proboscis, that is, the pharynx and its formidable jaws, and the welcome morsel was hooked with a jerk into the burrow. How deceptive are appearances. Vegetarian indeed! My Nereids are rabid carnivores. Thence on I fed the Nereids beef whenever I fed the Actiniæ.

To the naturalist who uses the microscope, an old marine aquarium is fruitful of interesting minute forms of life, both plants and animals. This is certainly true of the micro-algæ. I observed one day what seemed to me a new form of algæ, little clusters of a deep orange color on the sandy floor of the aquarium. Each bunch was hardly more than an eighth of an inch in diameter. Some of the little cylinders of which a cluster was composed were put under the microscope. There was not the slightest appearance of any cell structure, nor even the presence of any distinct protoplasm. They were granular in composition, but there was no sac or case. They had something of the look, size excepted, of the casts in Bright's disease. These little tufts of tiny orange-colored cylinders kept on increasing. When two or three days old they turned white. I noticed that they were all in proximity to the burrows of the Nereids. They proved to be their excreta—enteric casts of their imperfectly digested food. That deep dull orange was still a puzzle, for when freshly cast these excreta were exactly the color of the calcareous crust which covers the horny axis of some of the sea-fans, Gorgonia. It was noticeable that since the beef diet had been begun, the Ulva was let entirely alone.

But there arose a famine in the land. No *fresh* beef could be got. Of course the Nereids could go back to the sea-lettuce, but they chose to let it alone. From "pickings" they turned to "leavings," or perhaps more correctly from "primes" to "middlings." Thanks to the gentle Cowper whose Task supplies the word befitting ears polite—every "stercoraceous heap" was soon eaten up! Our pretty Nereis, then, has a threefold appetency—since it is by turns a vegetarian, a carnivore, and even an autostercophaga! an eater of its own casts.

But such things are found in higher quarters. Dr. Rau, in his translation of the Jesuit Baegert, says of certain California tribes now extinct, that in its season they almost lived upon the fruit of the pitahaya, and when that gave out they were reduced to short rations. Says the missionary:

"In describing the pitahayas I have already stated that they contain a great many small seeds resembling grains of powder. For some reason unknown to me these seeds are not consumed in the stomach, but pass off in an undigested state, and in order to save them the natives collect during the season of the pitahayas that

which is discharged from the human body, separate the seeds from it, and roast, grind and eat them, making merry over their loathsome meals, which the Spaniards therefore call the second harvest of the Californians." See Smithsonian Report, 1865, p. 365. Baegert's book was published at Mannheim, 1773.

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LIFE AND NATURE IN SOUTHERN LABRADOR.

BY A. S. PACKARD.

(Continued from p. 275 March number.)

AFTER roaming over the island and making pretty full collections of the insects, we paid attention to the marine zoölogy. Shore collecting is not as remunerative in Labrador as on the Maine and Massachusetts coasts. The most noticeable form is the six-rayed starfish (*Asteracanthion polaris*) which sometimes measured twenty inches from tip to tip of its opposing rays; its color was a dirty yellowish white, not red as in the common fire-finger, also abundant. The polar starfish is common in Greenland, and is a truly arctic form.

The common crab (*Cancer irrorata*) frequently occurred under stones, but the lobster was neither seen nor heard of; though common on the southern shores of Newfoundland it does not reach north into the Straits of Belle Isle. Among the worms which occurred at low water mark was the Pectinaria. On the New England coast it only occurs in deep water below tide mark.

Dredgings were first made at the mouth of Salmon river, a few rods from shore, in some eight fathoms of water in a firm deep mud. The most characteristic shells were gigantic *Aphrodite greenlandica*, large cockles (*Cardium islandicum*), as well as the pelican's foot (*Aporrhais occidentalis*), which occurred of good size and in profusion. In the soft mud occurred multitudes of the neat little sand star (*Ophioglypha nodosa*). Another form dredged on rocky bottom was *Cynthia pyriformis*, or the sea peach, and large specimens were cast up by the waves on the beach. Every spare day was given to dredging, and having been deeply interested in marine zoölogy by the writings of Gosse, in England, and of Stimpson in this country, and having obtained a good idea of the local marine fauna of Casco bay, in Maine, it was with no little interest and expectation that we dropped the

dredge in arctic waters, and we were not a little delighted with the result of finding so near shore and in such shallow water, forms which off the coast of Maine, in deep water, were rare and usually but half grown.

July 25th a party of us rowed up Salmon bay and went a mile up the river. The tide was out and we looked for the fresh-water mussel (*Alasmodon arcuata*), which is our northernmost species, and inhabits the rivers of Southern Newfoundland. We could find none, although the settlers told us that mussels, clams and "oysters" were common enough in the river. But something better was discovered. We found traces of genuine Quaternary marine sands and clays containing fossils. There were several banks of sand and clay along the edges of the river. In the latter I found *Aphrodite groenlandica* and *Aporrhais occidentalis*, with *Buccinum undatum*. They had been washed out of the clay into the bed of the river, and were collected at low water. I also dug several inches into the clay bank and found the disintegrated shells of the Aphrodite, so as to leave no doubt but that the shells were fossils. Down at the mouth of the stream at the head of the bay, on the flats, I found several *Buccinum undatum*, and quite a number of Aporrhais, young and old, broken and entire. On each side of the river was a terrace of sand and clay, with a thick growth of alders and willows, with the fire-weed (*Epilobium angustifolium*), the golden rod and a large cruciferous plant common in the mountainous parts of New England; also *Comarum palustre*, and a Thalictrum. Farther back and mostly lining the banks was a dense growth, impossible to penetrate save occasionally where there was a break in the thicket of spruce and a birch, perhaps *Betula populifolia*. Still farther up and away back stretched the bare moss-covered hill tops, the summer resort of deer and caribou. Here we saw a ptarmigan. But this was one of our halcyon days, of which there were few, as the last two weeks of July were stormy and wet. The clear fair-weather winds were from the south-west; the south-east winds brought in the fog and rain, while the northerly winds brought a few curlew, the advance guard of the hosts which were to arrive early in August.

The 3d of August was a fine day. A party of us went up the Esquimaux river to Mrs. Chevalier's, whose husband, now dead, entertained Audubon when visiting this coast. The sail up the

river was a pleasant one. It was about three miles from its mouth to an expansion of the river, on whose shores were four or five winter houses. Although most of the settlers live on the coast through the year, some have their winter and summer houses. Those who live up the interior, sometimes a distance of seventy miles from the coast, where there is wood and game, move from the shore about the 20th of October. They spend a month in cutting wood, a family burning through the winter about thirty cords. Then succeeds a month of hunting and trapping. The snow does not come, we were told, until the last of December, although we should judge this to be an extreme statement, and the snow is not usually more than three feet deep. The people profess to like the winter better than the summer. They shoot deer, foxes, &c., black fox being sometimes secured, whose skin is worth between two and three hundred dollars. Grouse are abundant, a good hunter securing from sixty to seventy a day in favorable seasons. At any rate fresh meat is obtained for each family two or three times a week.

The houses are small, built of wood, boarded and shingled, seldom constructed of logs, and are heated by peculiar stoves, great square structures resembling Dutch stoves, and heating the whole house, the two living rooms opening into each other, the stove being placed partly in each.

The French residents at the Mecatina islands, more social and gayer than the phlegmatic English settlers about the mouth of the Esquimaux and Salmon rivers, spend the winter evening in dancing and other gayeties to which the Anglo-Saxon, in Labrador at least, is a comparative stranger.

The Esquimaux river at its eastern entrance is but a few rods wide. Passing Esquimaux island we sailed out into a broad bay or expansion of the river, with ravines leading down to it, and under the steep bank protected from the northerly winds were the winter houses previously described. Up the river, just beyond Mrs. Chevalier's, the river contracted into narrows with rapids; it then opened into another bay or expansion two miles wide, the river being a succession of lakes connected by rapids, and this is typical of the rivers and streams of the Labrador peninsula. A barge cannot sail up the Esquimaux river more than fifteen miles, although one can push farther on in a flat boat. We were told that the river is about two hundred miles in length, and although perhaps the largest in Labrador it has never been explored.

Here we met the black flies in full force, and although we had been fearfully annoyed by them in rambling over Caribou island, here they were astounding, both for numbers and voracity. The black fly lives during its early stages in running water. The insect finds nowhere in the world such favorable conditions for its increase as in Labrador, over a third of whose surface is given up to ponds and streams. The insides of the windows of Mrs. Chevalier's house swarmed with these fiends, the children's faces and necks were exanthematous with their bites; the very dogs, great shaggy Newfoundlanders, would run howling into the water and lie down out of their reach, only their noses above the surface. The armies of black flies were supported by light brigades of mosquitoes. No wonder that these entomological pests are a perfect barrier to inland travel; that few people live during summer away from the sweep of the high winds and dwell on the exposed shores of the coast to escape these torments. They are effectual estoppers to inland exploration and settlement.

Accepting our hostess' kind invitation to take dinner, we sat down to a characteristic Labrador midday meal of dough balls swimming in a deep pot of grease with lumps of salt pork, without even potatoes or any dessert; nor did there seem to be any fresh fish. The staples are bread and salt pork; the luxuries game and fish; the delicacies an occasional mess of potatoes, brought down the St. Lawrence once a year in Fortin's trading schooner.

Over the mantelpiece was a stuffed Canada grouse or partridge and a ptarmigan in its winter plumage, but I was most delighted with the gift of some Quaternary fossils with which Mrs. Chevalier kindly presented me, including large specimens of *Cardita borealis*, *Aporrhais occidentalis* and, most valuable of all, the valves of a brachiopod shell, which I had also dredged on the coast in ten fathoms, the *Hypothyris psittacea*. On our return down the river we fished up the valves of the *Pecten magellanicus*, the great scollop shell, which lives in five or six feet of water. This mollusk, which is locally known in Labrador by the name of "pussel," we afterwards obtained in quantity, fried it in butter and meal, finding it to be delicious eating, combining the properties of the clam and oyster, the single large adductor muscle being far more tender than that of the common scollop of Southern New England and New York.

With our man, James Mosier, and his sailboat we spent two days in dredging in from forty to fifty fathoms out in the Straits of Belle Isle, three or four miles from land. The collection was a valuable one, containing some new species. The crown of the bank which we raked with our poorly constructed dredge was packed with starfish, polyzoans, ascidians, shells, worms and Crustacea. The collection was purely arctic, and had not the only dredge I had become broken, we should have reaped, or rather dredged, a rich harvest. As it was, the novelties were quite numerous, and the interest and excitement, as well as labor, of overhauling, sorting and preserving what we did obtain lasted for several days.

The only plant besides stony vegetable growths called "nullipores" dredged at this depth was a delicate red sea-weed, the *Ptilota elegans*; which was found afterwards to extend as far down in depth as ninety fathoms. Those who glibly talk, on *terra firma*, of plant life as affording a basis for animal life, should dredge in deep water. They will find that a vast population of animals of all sorts and conditions in the scale of life is spread at all depths over the sea bottom, thriving almost without exception on one another—on animal protoplasm—and in the beginning of creation animal life was without doubt contemporaneous in appearance with vegetable existence. Indeed, what is the difference in form and structure between a bacterium and a moner? The two worlds of plant and animal life arise from the same base, a common foundation of simplest structure, showing none of the distinctive characteristics of animal or plant life, and only barely earning the right to be called organisms, that vague term we apply for convenience to any, even the simplest structures endowed with life.

Of all the pleasures of a naturalist's existence, dredging has been, to our mind, the most intense. The severe exertion, the swimming brain, the qualms of sea sickness, tired arms and a broken back, the memory of all these fade away at the sight of the new world of life, or at least the samples of such a world, which lie wriggling and sprawling on the deck of the sailboat, or sink out of sight in the mud and ooze of the dredge, to be brought to light by vigorous dashes of water drawn in over the side of the boat. Those days of dredging on the Labrador coast, where there was such an abundance and luxuriance of

arctic varieties, were days never to be forgotten. There is a nameless charm, to our mind, in everything pertaining to the far north, the arctic world, and we can easily appreciate the fascination which leads one back again to the polar regions, even if hunger and frost had once threatened life. Arctic exploration has but begun, and though its victims will yet be numbered by the score, enthusiasts will yet attempt the dangers of arctic navigation, and fresh trophies will yet be won.

Early in August, during the few still clear nights succeeding bright and pleasant days, we had auroras of wondrous beauty, not excelled by any depicted by arctic voyagers.

On the 10th of August the curlews appeared in great numbers. On that day we saw a flock which must have been a mile long and nearly as broad; there must have been in that flock four or five thousand! The sum total of their notes sounded at times like the wind whistling through the ropes of a thousand-ton vessel; at others the sound seemed like the jingling of multitudes of sleigh bells. The flock soon after appearing would subdivide into squadrons and smaller assemblies, scattering over the island and feeding on the curlew berries now ripe. The small snipe-like birds also appeared in flocks. The cloud berry was now ripe and supplied dainty tid-bits to these birds.

By the 18th of the month the golden rods were in flower. Here, as has been noticed in arctic regions, few bees and wasps visit the flowers; the great majority of insect visitors are flies (Muscidæ), especially the flesh fly and allied forms. A bumble-bee occasionally presents himself, more rarely a wasp, with an occasional ichneumon fly, but the two-winged flies, and those of not many species, were constant visitors to the August flowers. The black flies still remained to this date terrible scourges in calm weather, though in cloudy days and at night they mostly disappeared.

Wandering through the fog and drizzle along the mud flats on the northern side of the island I picked up *Aporrhais occidentalis*, *Fusus tornatus*, *Cardita borealis*, large valves of *Saxicava rugosa*, Buccinum and *Astarte sulcata* and *compressa;* these and *Pecten islandicus* and other shells forming much the same assemblage as I had dredged a few days previous out in the straits in fifty fathoms. The only recent shells lying about were shallow-water forms, such as the common clam, *Tellina fusca* and the razor

shell. It was evident that here was a raised sea-bottom, and the Quaternary formation. In the afternoon I returned to the spot and dug up many more shells mingled with pieces of a yellow limestone containing Silurian fossils, brachiopods and corals. This horizon, then, represented a deep sea-bottom, over which the open sea must have stood at least 300 feet, while the clay fossils of the mouth of the Esquimaux river must have lived in a deep muddy bay sheltered from the waves and currents of the open sea. The drift deposits of Labrador are scanty in extent compared with those of the Maine coast. They are but isolated patches compared with the extensive beds of sand and clay which compose the Quaternary deposits of New England.

On the 22d August we made our last excursion up the Esquimaux river, going up some six miles from its mouth. From a hill top I could look over the surface of this lake-dotted land. The surface was rugged and bare in the extreme. The river valley, however, was well wooded, the spruce and birch perhaps thirty feet in height. Here and there the river passed through high precipitous banks of sand. The hills were rough, scarred with ravines, precipices, and deep gaps, the syenite wearing into irregularly hummocky hills, the rough places not filled up with drift, and thus the contours tamed down as in New England. Indeed, Labrador at the present day is like New England at the close of the ice period or at the beginning of the epoch of great rivers, before the terraces were laid down and the country adapted for man's residence. Labrador was never adapted for any except scattered nomad tribes. It is still an unfinished land.

While the hills were bare and the rocks covered with the reindeer moss, here and there by the river's edge in favorable, protected places were tall alders and willows, with groups of asters and golden rods. Here I saw a veritable toad, and glad enough was I to recognize his lineaments. I was also told that there were frogs in existence, though we never saw or heard them. There are no snakes or lizards, so that our history of these animals in Labrador will be as brief as that of the Irish historian, but we did find a small salamander at Belles Amours in a later trip to this coast.

On our return we found that a whaler had towed a whale into the month of the river and was about to try out the oil. We secured a piece of the flesh, and on reaching camp boiled it; it

was not bad eating, tasting like coarse beef. Seal's flippers we also found not to be distasteful, though never to be regarded as a delicacy.

Dredging and collecting insects on fine days when not too calm filled up the measure of our seven weeks. The time passed rapidly, the days were too short for all the work we planned to do, and it was not without regret that we left the rugged untamed shores of the Labrador. On the afternoon of the very day she had set for her return to Caribou island, the *Nautilus* hove in sight. As she made our harbor she struck upon a sunken rock, tore off a piece of her keel, but slid off and came to anchor as near as practicable to the mission house, and then succeeded the mutual spinning of Labrador and Greenland yarns by the reunited party.

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RECENT LITERATURE.

COPE'S VERTEBRATA OF THE TERTIARY FORMATIONS OF THE WEST.[1]—Just ten years ago (1875) a bulky quarto volume on the Vertebrata of the Cretaceous formation of the West, by Professor Cope, appeared, forming the second volume of the memoirs of the Hayden Geological Survey of the Territories. The ponderous volume now before us contains between three and four times as many pages and about fifty more plates. The work is designed to present figures and descriptions of the vast number of species of vertebrates of all classes, but more especially of the mammals of the Tertiary lake-basins of the West. For the first time the palæontologist has before him the materials for a view of that rich fauna which through the Tertiary period crowded the shores of the immense lakes whose sediments form the surface of our Western plains—a fauna whose descendants, vastly less in number though more highly specialized, still survive on this continent.

The subject is naturally the most attractive the palæontologist could have presented to him, since the materials represent a number of extinct orders, suborders and families, which fill more or less completely the wide gaps between the existing orders of mammals, and enable the student to examine the foundations, so to speak, upon which the existing groups have been built up; this, of course, has led not only to the solution of knotty points in classification, but to broader conceptions of the relations of the

[1] *U. S. Geological Survey of the Territories.* F. V. Hayden in charge. The Vertebrata of the Tertiary formation of the West. Book I. By EDWARD D. COPE. Washington, 1883–4. 4to, pp. 1009, with over 100 plates and numerous wood-cuts in the text.

extinct to the living groups, their genealogy, and finally the origin of the class itself from the lower vertebrates.

The points of special value to palæontology and bearing on the doctrine of evolution, worked out by Professor Cope in this volume, are quoted from Professor Hayden's letter of transmission to the Secretary of the Interior:

"1. The discovery of the fauna of the Puerco group, of thirty genera and sixty-three species. This includes many important details, such as the discovery and definition of three new families with many species of a new order, the Taxeopoda, as the Periptychidæ, Meniscotheriidæ, and a new suborder, the Taligrada, represented by the genus Pantolambda; also the discovery of the Plagiaulax type (of the Jurassic) and other marsupials, and the Laramie saurian genus Champsosaurus in the Puerco group.

"2. The new classification of the Ungulata rendered possible by the discovery of the complete remains of the Wasatch types of Phenacodus and Coryphodon, especially the former, from Wyoming Territory. The light thrown on the phylogeny of the Ungulata by this discovery exceeds that derived from all other sources together.

"3. The new classification of the lower clawed mammals, based on the analyses of fifteen new genera and forty-seven new species of flesh-eaters and six new genera and sixteen new species of allied forms, all discovered since the publication of the author's volume in connection with the Wheeler survey.

"4. The restoration of Hyracotherium, the four-toed horse of the Wasatch group.

"5. The restoration of the genera Triplopus and Hyrachyus of the Bridger fauna.

"6. The determination of the systematic relation of the Dinocerata as seen in the genera Loxolophodon and Bathyopsis.

"The whole number of genera described in this volume is 125 and of species 349, of which 317 species were determined by Professor Cope.

"The explorations that furnished the materials for these volumes began in 1872 and are still being continued. It will therefore be readily seen that the amount of new matter towards the origin and history of the Mammalian group, brought together by the author in these two volumes, is most extraordinary, and will probably never be surpassed."

The explorations for the fossils here described were made by the author largely at his own expense, and full acknowledgment is made of the services of those who made the collections when the author was not in the field, and of the preparator in the laboratory.

The volume lay for a year in the bindery, so that while printed in 1883 it was not bound until 1884, and was not distributed until February of the present year.

Some typographical errors are not corrected in the errata, this is probably due to the fact that the printing was done mostly during the summer while the author was in the field, while a large amount of proof was sent to Mexico and there lost.

The present volume is divided into two parts, Part I relating to the Puerco, Wasatch and Bridger faunæ (Eocene); and Part II comprising the White River and John Day faunæ, Lower and Middle Miocene. Vol. IV is in preparation and will comprise the Upper Miocene fauna (Ticholeptus and Loup Fork fauna) and the Pliocene.

The introduction is divided into two sections, in the first of which the character and distributions of the Tertiary formations of the central region of the United States are noticed. In the second section are discussed the horizontal relations of the North American Tertiaries with those of Europe.

Then follow the description of the fossils, beginning with the fishes and ending with the mammals.

The general conclusions as to affinities and phylogeny are appearing in the NATURALIST in a series of articles which began two years ago.

The work is richly illustrated, the details amply supplementing the descriptions. As the result of extended investigations by an experienced comparative anatomist and morphologist, as well as palæontologist, this and the preceding volumes mark an epoch in American palæontology. It is a monument of energy and devotion to science, signalizing the triumphs of severe and trying physical labor in the field, as well as patient, comprehensive and searching work in the laboratory and study.

CLAUS' ELEMENTARY TEXT-BOOK OF ZOOLOGY.[1] — The larger work of Professor Claus is the latest and most authoritative treatise on systematic zoölogy, having passed through four editions. This work, somewhat cut down in size, is the original of the present one. As it is, the first part is a bulky octavo, and, as when completed it will be in two volumes, the book will not be so easy of reference as if it formed a single volume. The book in its English dress is richly illustrated, the cuts, for the most part, carefully prepared, mostly selected by Dr. Claus himself. To the general part are devoted 179 pages; the usual subjects of organic and inorganic bodies, animals and plants, cells and tissues, correlation of organs, accounts of the different organs, intelligence and instinct, development and evolution receiving full and accurate treatment, though the author's style is at times heavy and prolix, the translators not always adding perspicuity or elegance to the cumbrous German expressions. For example, on

[1] *Elementary Text-book of Zoölogy.* General part and special part: Protozoa to Insecta. By Dr. C. CLAUS. Translated and edited by ADAM SEDGWICK, with the assistance of F. G. HEATHCOTE. With 706 woodcuts. London, W. Swan Sonnenschein & Co., Paternoster square, 1884. 8vo, pp. 615.

p. 1 the ordinary student will stand aghast at the following sentence: "The matter of unorganized bodies (for instance of crystals) is in a state of stable equilibrium, while through the organized being a stream of matter takes place." Do not streams generally flow? The punctuation is also defective, and cases of tautology occur. Why at this date there should be any distinction, even if in words, expressed between sarcode and protoplasm we do not understand. On p. 21 we find the following sentences in the section on the difference between animals and plants: "In the place of muscles, which as a special tissue are absent in the lower animals, there is present an undifferentiated albuminous substance known as sarcode, the contractile matrix of the body. The viscous contents of vegetable cells, known as protoplasm, possesses likewise the power of contractility, and resembles sarcode in its most essential properties." There is vegetable and animal protoplasm, but why give different names to what is fundamentally the same substance? Throughout the succeeding pages the word protoplasm is used for the contents of animal cells, and we read no more of sarcode.

The translator has, on p. 70, referred to the "spiral thread" of an insect's trachea, sufficient liberty might have been taken with the original to have given the latest and most correct view as to the structure of the trachea and the mode of tracheal respiration, as worked out by Professor Macloskie; although it should be stated that his paper did not appear until May last (see this journal, XVIII, p. 567). The statement concerning and figures of the nervous system of the Echinoderms might have been modernized and made more complete in the light of the discoveries of the two Carpenters, Marshall and Jickeli. There is otherwise but slight occasion for fault-finding, as Claus is evidently a sound, cautious compiler, and we should expect any slight inaccuracies to have been corrected by the able translator.

Passing to the systematic part, under the Protozoa we notice that Bathybius is mentioned, though with doubt, while no reference whatever is made of Eozoön. As an appendix to the Protozoa is a section devoted to the Schizomycetidæ, "which approach more nearly to the Fungi," and with them are treated the Gregarinidæ. The sponges are associated with the Cœlenterates, a view not, we think, either true or conducive to clearness.

The second subgroup of Cœlenterates proper (the sponges forming subgroup 1) are called Cnidaria, and for Hydrozoa we find substituted the term Polypomedusæ; it should also be mentioned that the Anthozoa are placed lower than the Hydrozoa. Balanoglossus, the representative of the class Enteropneusta, is placed between the Echinoderms and worms.

We wish a figure of the adult of the singular worm Polygordius had been given, though a good sketch of its larva appears, but the excellence of the majority of the figures and the judg-

ment shown in their selection are almost beyond criticism. Why the Gephyrea and the Hirudinea are placed above the more highly specialized Chætopod worms we do not understand. As also why the Phyllopods should be placed at the base of the Crustacea, below the Copepoda and barnacles. This classification has been strenuously advocated by Claus, but not, we suppose, generally accepted; the reasons militating against this view are many and urgent; the Branchipodidæ, with their stalked eyes and highly specialized bodies, appear to stand nearer the stalked-eyed Crustacea than any other Entomostraca; and to go directly from the root-barnacles to the Malacostraca is straining more than one point in taxonomy. In treating the trilobites no reference whatever is made to American work, especially that of Walcott, who has demonstrated that they had hard jointed limbs; Claus states the obsolete view that they were "soft and delicate."

Among the Myriopods Pauropus is assigned to the Polydesmidæ, when it certainly represents a distinct suborder if not order. The Physopoda or Thrips are regarded as a tribe of Pseudo-neuroptera, although embryology shows they are Hemiptera. The taxonomy of the Lepidoptera seems to us to be very objectionable and old-fashioned, while it is a comfort to see that the Hymenoptera are placed at the head of the insect series. We shall look with great interest to the appearance of the second, closing volume.

GOODALE'S PHYSIOLOGICAL BOTANY.[1]— In the year 1879 Dr. Gray brought out the new (sixth) edition of his widely known and used Botanical Text-book. The new book covered much less ground than the older editions, being confined to the structural botany of the phanerogams. It was then announced that Dr. Goodale was to prepare a second volume to be devoted to physiological botany, Dr. Farlow a third devoted to cryptogamic botany, and that the series was to be completed by a fourth volume to include a sketch of the natural orders of phanerogams. After waiting six years we have the pleasure of perusing advance sheets of the long-promised Vol. II. The part before us is devoted to the histology of the phanerogams, and is soon to be followed by Part II, which is to deal with vegetable physiology.

Upon opening the book we have first an interesting chapter devoted to histological appliances; a most useful chapter indeed it will prove to all workers in the botanical laboratory. In this we observe with pleasure the remark that "other things being equal, a microscope with a short tube and with a low stand will be most convenient on account of the large number of cases in which

[1] *Gray's Botanical Text-book* (sixth edition). Vol. II. Physiological botany. I. Outlines of the histology of phænogamous plants. By GEORGE LINCOLN GOODALE, A.M., M.D., professor of botany in Harvard University. Ivison, Blakeman, Taylor & Co., New York and Chicago. 1885. pp. vii, 194, 12mo, 141 figures.

reagents must be employed, their application requiring a horizontal stage."

In chapter I we have a discussion of the vegetable cell in general, its structure, composition and principal contents. Here it is encouraging to note that the author still holds to the view that the cell is the unit in vegetable anatomy. The most interesting portion of this chapter is that devoted to plastids (including chlorophyll), protein granules and starch. In chapter II the modifications of cells, and the tissues they compose, are taken up.

The provisional classification adopted is as follows:

I. Cells of the fundamental system, or PARENCHYMA cells—permanent typical cells.
   1. *Parenchyma* cells, strictly so-called, including as modifications *collenchyma* cells and *sclerotic* parenchyma cells, or grit cells, such as the lignified cells of seed-coats and drupes, etc.
   2. *Epidermal* cells and their modifications, *e. g.*, trichomes.
   3. *Cork* cells, forming suberous parenchyma, or cork.

II. Cells and modified cells of the fibro-vascular system—PROSENCHYMA in the widest sense.
   1. Cells of *prosenchyma* proper.
      a. Typical wood-cells and woody fibers, including libriform cells and the secondary wood-cells.
      b. Vasiform wood-cells or tracheids.
   2. *Vessels* or ducts.
      a. Dotted.
      b. Spirally marked.
      c. Annular.
      d. Reticulated.
      e. Trabecular.
   3. *Bast-cells*, bast-fibers or liber-fibers.

III. SIEVE-CELLS, or cribose cells.

IV. LATEX-CELLS.

It will be observed that four principal kinds of cells are here recognized, implying four kinds of tissues. Parenchyma is made to include collenchyma and short-celled sclerenchyma, and prosenchyma likewise includes fibrous cells as well as vessels (tracheary tissue).

Chapter III is devoted to the minute structure and development of root, stem and leaf of phanerogamous plants. The treatment of these subjects is very full and, to our mind, quite satisfactory, although one of the most difficult of clear presentation. The fourth and fifth chapters are devoted respectively to the minute structure and development of the flower, fruit and seed, and the physiological classification of tissues, both of which subjects are briefly treated. The last chapter is particularly interesting, and one finishes reading it with the regret that it had not been made longer.

We shall reserve the discussion of some points in the chapters before us until after the appearance of part second, but in the

meantime must congratulate the botanical fraternity of this country upon the appearance of this profound and still clearly written work.—*Charles E. Bessey.*

SMITH'S DISEASES OF FIELD AND GARDEN CROPS.[1]—In this compact little volume the author has brought together the notes of a course of lectures given at the request of the officers of the Institute of Agriculture at the British Museum, South Kensington. It was the endeavor of the author, we are informed in the introduction, to keep three objects clearly in view, viz., "*first*, the description only of such diseases as are of economic importance; *second*, the definition of all the phenomena of the diseases in familiar words, such as, with proper attention, may be understood by all; this has been done without sacrificing scientific accuracy, as all botanical terms in common use are adverted to and explained; *third*, the consideration of the best means of preventing the attacks of plant diseases."

An examination of the book warrants us in saying that the author has succeeded admirably in his attempt. Every progressive farmer and gardener ought to procure this book and give it a careful reading.

While thus commending this book as a most excellent one in plan and purpose, we need not accept all the author's views. But this will not necessarily lessen the value of the work for those for whose benefit it was designed.—*Charles E. Bessey.*

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[1] *Diseases of Field and Garden Crops, chiefly such as are caused by Fungi.* By WORTHINGTON G. SMITH, F.L.S., M.A.I., member of the scientific committee Royal Horticultural Society. With 143 illustrations drawn and engraved by the author. London, Macmillan & Co., 1884. pp. xxiv, 353, 12mo.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Asia.—*The Island of Formosa.*—A paper recently read by Mr. M. Beazeley, before the Royal Geographical Society, gave much information about this little-known island, and elicited more from other members. The Chinese do not seem to have been acquainted with the island until 1403, although it is distinctly visible from the mainland and islands of the Chinese coast. So little did the Chinese emperors know or care about it, that in 1624 they ceded it to the Dutch in exchange for the small group of the Pescadores. Previously to this the Spanish and Portuguese had traded there, and it is supposed that the curious red brick fort at Tamsui, now the British consulate, was built by the Spaniards in the 16th century. The Dutch drove the Japanese from Anping, fortified themselves in Fort Zelandia, and held the island until they were driven out by the celebrated piratical chieftain, Ching Ching-kung, whose grandson handed the island over to the Chinese government, and received his pardon.

Formosa strait, between the island and the mainland, is 245 miles wide at its southern end, but only 62½ at its northern end. The island is 245 miles in greatest length, and 76 in greatest width, and is computed to contain 14,982 square miles. A range of mountains, averaging about 12,000 feet in height, extends down the center of the island for the greater part of its length. The ridge of this range is extremely level, though heights varying from 11,300 to 12,850 feet have been made out. Mr. Beazeley declares them to be wooded to the very top, but Mr. Barber states that he has seen snow on the northern parts of the range late in June. There are now no good harbors in Formosa, owing to the fact that the island is rising at quite a perceptible rate. During the Dutch occupation in the 17th century the capital, Taiwanfu, was a port, Fort Zealandia was an island far out to sea, and an extensive harbor and bay separated the two. This is now a level plain of many miles in extent, and passengers are landed in catamarans at Anping, under the ruins of the old fort. Anping is merely an open roadstead with no shelter in the south-west monsoon, during which no vessels visit it. Tamsui, in the north, is at the mouth of a river, with only 1½ fathoms on the bar, and 2½ fathoms inside, with bad holding-ground. Kelung, also in the north, is very small and much exposed during the north-east monsoon. Takow, in the south-west, twenty-four miles south of Anping, has a shifting bar and a very narrow entrance, while only the outer end of the lagoon affords anchorage. There is a small harbor at Sao bay on the east coast. The neighboring small group of the Pescadores has two fine harbors, Ponghou and Makung, and it would be absolutely necessary for any foreign

[1] This department is edited by W. N. Lockington, Philadelphia.

power that wished to hold Formosa to possess these harbors. At present Amoy is practically the port of Formosa, and the produce of the island is sent thither in small vessels. There are no active volcanoes in the island, but there are signs of volcanic action in boiling springs, etc., and earthquakes are frequent.

When Mr. Beazeley accompanied a party in 1875 to select a site for a lighthouse at the South cape, Chinese authority had not extended so far as it now has, and it was not without much difficulty and some danger that the travelers made their way from Takow to the cape. The Chinese inhabitants of the country are described as apparently well-to-do, the villages clean and the children, who are mostly naked, healthy and strong. The mangoes grown in Formosa closely resemble the Bombay mango in appearance and flavor, and the pineapples are without a crown of leaves. The aborigines are much darker and more muscular than the Chinese, wear nothing but a scanty blue cloth round the waist, and are armed with bows and arrows and long knives. Many carry matchlocks. In shape Formosa has been compared to a cleaver with a short handle, or to a fish, the tail or handle being the narrow part just north of the South cape. It is certainly one of the most beautiful and fertile spots on the face of the earth.

Northern Afghanistan.—The northern part of Afghanistan is watered by the Heri-rud, Murghab and affluents of the Amu-Daria, and thus belongs to the Aralo-Caspian basin. The Afghans do not extend beyond the mountains (Hindoo Koosh, Parapomisus, etc.) except in the north-west at Herat, though they hold in military subjection the Mongol tribes of the lowland areas. The Hazareh, etc. (Mongolian) of the mountains east and south-east of Herat are independent, and the region between the Murghab and Heri-rud is occupied by Turkoman tribes, among whom are about 30,000 who have recently come southward from Merv. Eastward of these Turanian tribes are various peoples of Iranian race, some of whom are thought to be the aboriginal inhabitants of this mountain land—the supposed cradle of the Aryan stock. Among these are the Black Kafirs or Siah-posh, who alone of these tribes have not embraced Mohammedanism, who use tables and chairs and into whose country an Afghan dare not penetrate. North of these are the Badakshi. The Russians claim that the Hindoo Koosh forms the northern limit of Afghanistan, but north of this line, at its eastern extremity, Aryan tribes extend even to Darwaz and Karateghin.

Asiatic Notes.—Two hundred and fifty representatives of the Hsi-Fans, or tributary aboriginal tribes of Thibetan race which live scattered along the Thibetan border of China from Yunnan to Kan-su, are now in Pekin. The Hsi-Fans are short, fond of red clothing, and adopt Chinese fashions in no small degree. Their faces are rounder than those of the Chinese, their heads

smaller, their noses less stunted, small and pointed. Their eyes are small, placed in a line, and have a bright black luster. Quiet though they are now, history shows that they struggled manfully against the Chinese. The Lolos of Sze-Chuan are allied to the Burmese, and seem to form a nation. Both they and the Hsi-Fans belong to the Eastern Himalaic, while the rest of the aboriginal tribes in Western China and in the southern provinces, whether Miao, Rao or Tung, seem to belong to the Eastern Himalaic, the branch to which belong the Siamese, Shans, Laos, the Li of Hainan, the Cambodians and the Anamese.——Dr. Grishimailo's travels in Ferghana and the Altai have resulted in large geological and entomological collections, as well as in much anthropological matter. Many evidences of the existence of a glacial epoch in Central Asia were met with, amongst them the presence in Thian-shan of forms which have hitherto only been found in Labrador, Greenland, Lapland and the Swiss Alps.——M. Ed. Cotteau has ascended several of the Javan volcanoes, viz., Mt. Cheda, 9844 feet; Mt. Merapi, 9459 feet; Mt. Bromo, 8203 feet, and still active; and Mt. Smeru, 12,469 feet high, the culminating peak of Java. M. Cotteau states that to one accustomed to Swiss mountain-climbing the ascent of these volcanoes is child's play.

AFRICA.—*African Notes.*—M. Dolisie, a member of the Brazza mission, has traveled from Loango to Brazzaville. The "king" of the country gave to the traveler an excellent piece of ground at the confluence of the Ludima with the Kuilu, and had signed a treaty placing all the country between the Ludima and the Niari under the protectorate of France. This prince and all his chiefs also signed a solemn declaration that they had never ceded any of their rights to the International Society, which did not even own the land on which their stations were built. The route was preferable to that of the Congo and even to that of the Ogowé. Both the entrances of this route on the coast of Loango and its termination at Brazzaville are in the hands of France.——M. Giraud has again been unsuccessful in his attempt to continue his explorations, having been abandoned by his porters and his escort.——The French have the command of the Niger from Bourré to Boussa, some 700 leagues of watercourse. From the north of Africa a French railway runs from Arzen to Mécheria, and in a few years will be extended to Imsalah, which is already connected with Timbuctoo by caravan routes. The latter will become more important under French protection. The French will certainly also push from Porto Novo on the Gulf of Guinea to Boussa on the Niger, and thus complete their communication between the Mediterranean and the Gulf of Guinea.——Dr. Colin, of the French navy, has recently explored the valley of the Faléme, one of the most considerable affluents of the Senegal. The river, though it cannot be considered navigable, can be made so by removing a few rocks which obstruct its pas-

sage. Small canoes ascend it even now, and it could easily be made accessible to small steamers, since it has neither falls nor rapids. Life is intense throughout the valley, the vegetation for from one to three hundred meters on each bank is so thick that it was only at intervals that our traveler could approach the river; elephants, lions, buffaloes, antelopes, etc., as well as birds abound, and numerous villages are situated within a few kilometers of its course. Gold is found in its sands. Leaving Podor June 24, 1883, he left the Faléme at Senondébau, an abandoned French fort, and proceeded thence to Dialafara, the capital of Tambura, a country rich in cattle and gold, and induced the sovereign to sign a treaty of protectorate. From Dialafara Dr. Colin went to Kassama, capital of Diébedugu, a city before unknown to Europeans. Kassama seemed so important that Dr. Colin endeavored to find a practicable route from thence to the terminus of the French railway at Bafulabé, but failed.——M. Tomczek, the companion of M. Rogovinski in the exploration of the Cameroons region, died at Mondoleh, May 10, 1884, aged 24 years. Notwithstanding his youth, he had got together a vocabulary of the Kruman language, explored the Rio del Rey, and taken many notes upon the country.——Not only M. Rogovinski, but M. Passavant of Basle, has resolved to advance into the interior of the Cameroons region in search of the mysterious Lake Liba.——In his last journey Mr. Stanley ascended the Aruwimi to Tambuga, 2° 43′ N. lat. At that point the river is called Biyere, farther on it is the Berre and the Werré, and Mr. Stanley believes it to be identical with the Welle of the south of the Soudan. He discovered on this journey the Lulemgu, an important affluent upon the right bank, and established a station upon the island of Wana-Rusani, near the right bank of the river, in 0° 10′ N. lat.

AMERICA.—*Norse and Portuguese Colonies in North America.*—Mr. R. G. Haliburton (Proc. Roy. Geog. Society, January, 1885) identifies the "Vinland the Good" of Eric the Red with Newfoundland. The length of the day given in the Greenland Saga coincides with that of Newfoundland, and the man who called his first find Greenland in order to attract colonists, would not scruple to give a good name to the land found by his son, Leif. Wild grapes are said to occur on the west coast, and this was enough for Eric to magnify into shiploads of grapes and a semi-tropical winter climate. The Helluland of the Saga is, by Mr. Haliburton identified with Labrador, the southern part of which was Markland, while Genunga gap was Belle Isle strait. It was not known until the publication, in 1883, of "Os Corte Raes," by Senhor Ernesto do Canto, that from 1500 to 1579 commissions were regularly issued to the Corte Reals as governors of Terra Nova, and that at least three settlements were made by the Portuguese. Except, perhaps, the Vinland of the Norsemen, this colony, which included Labrador, Newfoundland, Nova Scotia

and probably a large portion of the east coast of the United States, was by far the oldest European colony in the new world, since the date 1500 is but two years after the discovery of America by Columbus and six years after its discovery by Cabot. In 1500 Gaspar Corte Real explored Labrador, probably nearly to Hudson strait, and also Newfoundland and Nova Scotia. In 1521 Fagundes obtained a grant of the country between the land of the Corte Reals (Newfoundland) and the Spanish colonies, and a settlement was made at Cape Breton. Traditions of this settlement exist among the Micmacs, who aver that certain earth-mounds at St. Peter's, Cape Breton, were made by white men before the French came. An archaic cannon, formed of bars of iron, was found many years ago, and an inquiry into the date of the manufacture of such guns showed that it must have been made between 1500 and 1545. Terra Nova was not actually settled, but the fisheries were actively prosecuted. The fate of this colony is not known, but in 1567 a Portuguese settlement was made at Inganish, Cape Breton. In 1580 the annexation of Portugal to Spain brought the region under Spanish authority, and a colony was sent out which appears to have had a melancholy end, since our only account of it is that the French convicts left on Sable island in 1598 built barracks to protect themselves out of the wrecks of the Spanish vessels. The name of "Spanish Harbor" is all that marks their passage. Few persons imagine that the Bay of Fundy is "*Baya Fonda*," the deep bay, and that Cape Race is "Cabo Raso," or bare cape, names given by the Portuguese.

Source of the Mississippi.—The true source of the Mississippi was found by Captain Glazier to be in a lake in lat. 47° 13′ 25″, and situated three feet above Lake Itasca, the hitherto supposed source of the river. The source is therefore 1578 feet above the Atlantic, and the length of the river, taking former data as the basis, may be placed at 3184 miles.

The Fuegians.—The total population of Terra del Fuego is not above 8000, consisting of about 2000 Onas, hunters, evidently of Tehuelch or Patagonian origin, in the east; about 3000 Alaculufs, hunters and fishers in the west and 3000 Yahgans, fishers, in the south. Numerous kitchen-middens of vast size and great age show that the island was inhabited even before the opening of Magellan straits. Those of Elizabeth island, the largest, oldest and most interesting, are from twenty to twenty-five feet above the sea-level, and are covered with a layer of fine sea-sand some forty-five inches thick, above which comes an accumulation of rich vegetable humus overgrown with herbaceous vegetation. The lower stratum of refuse contains *Mytilus patagonius* and other shells, with fragments of *Otaria jubata* and a few other mammals, but no split bones, human remains, traces of pottery or weapons, save a few rudely-shaped spear or arrow-heads. The modern heaps are very similar. In

the face of the great degradation of these peoples the English missionaries assert the language of the Yahgans contains no less than 30,000 words, "suggesting the hypothesis of an origin very different and far superior to their present state."

GEOLOGY AND PALÆONTOLOGY.

THE OLDEST TERTIARY MAMMALIA.—The lowest horizon of the Puerco epoch of New Mexico has recently been explored by David Baldwin with good results. The following is a list of the species of Mammalia obtained by him. The proportion of novelty, it will be seen, is large:

Polymastodon ? taoënsis Cope.

Polymastodon latimolis, sp. nov.—This marsupial equals the *P. taoënsis* in size, and is therefore larger than either the *P. fissidens* or the *P. foliatus*. It differs especially from both the *P. taoënsis* and the *P. foliatus* in the great shortness of the first true inferior molar, which is only one-half longer than the second or last true molar. The latter is as wide as long in the type, and a little narrower in a second specimen. It supports four tubercles on the inner side; outer side worn. The first true molar appears to have five tubercles on the inner side, although the anterior edge is injured. In *P. taoënsis* there are six or seven. The fourth premolar is two-rooted. The enamel of the last inferior molar is faintly longitudinally wrinkled. The coronoid process rises opposite the middle of the second true molar.

Measurements: Total length of molar series, M. .038; of second true molar .017; width of do. .011; length of crown of second true molar .014; width of do. .011. Depth of ramus at M. II .038; do. at diastema .024. Depth of ramus of a second individual .042. Besides the shortness of the second true molar, the width of the same tooth and of the last true molar distinguish this species from the *P. taoënsis*. The inflection of the angle of the ramus of the lower jaw is as well marked as in other species of the genus.

Chriacus hyattianus, sp. nov.—Represented by two maxillary bones with molar teeth, one of which is accompanied by a broken mandibular ramus, which supports the second true molar and parts of other teeth. The superior molars are quite peculiar, and are especially characterized by their small transverse as compared with their anteroposterior diameter. The crowns are surrounded by a cingulum, except on the inner side, where distinct traces of it are visible. The external cusps are small and low and flattened on the external side, and are connected at their bases by a low ridge. They send inwards each an angular ridge which unites with its fellow in an angular internal cusp of little elevation, enclosing a triangular fossa. Small angular intermediate tubercles exist at the internal bases of the external cusps. The posterior cingulum is a little better developed than the anterior, and rises

into a very small cusp or tubercle, which is not of sufficient size to truncate the internal outline of the crown. The crown of the second true inferior molar displays a contracted triangle of three well developed cusps anteriorly, and a wide basin posteriorly. The rim of this basin is elevated all round and develops into a cusp on the external side. An external, no internal cingulum. Enamel longitudinally wrinkled.

Measurements: Length of three true molars .0185; diameters of M. II, anteroposterior .0075, transverse .0075; do. of second inferior true molar, anteroposterior .0075, transverse posteriorly .006. As the fourth inferior premolar of this species is unknown, its reference to the genera Chriacus is provisional only. It is dedicated to my friend, Professor Alpheus Hyatt, of Boston, Mass.

Mixodectes ? sp.—Two rami with true molars.

Loxolophus adapinus, gen. et sp. nov.—*Char. gen.*—Known only from inferior molars. Crowns with three cusps anteriorly and a basin posteriorly. The internal and external anterior so connected as to form a transverse crest on a little wear; anterior or fifth cusp distinct. Rim of basin elevated on the external side and extending as a crest to the base of the anterior cusps. Internal rim acute, and so near the external as to resemble a large cingulum. Third true molar with a small heel. The position of this genus cannot be determined without further material. The oblique direction of the crests resembles what is seen in the genus Adapis Cuv.

Char. specif.—The posterior rim only rises into a cusp at the posterior external angle. There are no cingula. The enamel is slightly wrinkled longitudinally. The posterior molar is considerably smaller than the first, which is a little smaller than the second. The last molar rises obliquely with the anterior base of the coronoid process. The anterior masseteric ridge is quite predominant, but the fossa is not distinctly bounded below.

Measurements; Length of true molars .019; of last molar .006; width of do. .003; length of second true molar .007; width of do. .0045

Sarcothraustes coryphæus, sp. nov.—Represented by a considerable part of a cranium, which supports the true molars of both sides, and the fourth premolar of one side. The absence of the mandible leaves the generic reference somewhat uncertain. The superior molars resemble those of the *Triïsodon canidens* M., and those of the *Sarcothraustes antiquus* M. As these genera have been kept apart on account of differences in the superior dentition, and as only the true inferior molars of the former are known, and probably only the inferior premolars of the latter, both may belong to the same genus, *i. e.*, Sarcothraustes. The present species is smaller than either of the above-named, and differs in various points in the superior molars.

The crowns of the superior molars support two external conical cusps which stand close together, but are entirely distinct, and have a circular section. There is a single internal conical cusp flattened on the external side. The entire crown is surrounded by a well developed cingulum, which is especially prominent round the external anterior cusp of the second and third true molars. The posterior external cusp of the last true molar is rudimental, and is situated well within the external line on the posterior border. The fourth premolar has a single external cusp, and the cingulum is wanting on the anterior and interior sides. The outline of the base of the crown of this tooth is subtriangular; that of the first and second true molars is a half ellipse; while that of the last true molar is a transverse oval as in the two species mentioned above. In this last respect it differs from the species of Mesonyx and Dissacus, where that tooth has a triangular base. Enamel delicately wrinkled where unworn. In the two species of Sarcothraustes already mentioned the first and second true molars have a triangular outline, and there is no internal cingulum.

The occiput of this species rises into an elevated transverse crest with an oval outline, like that of the Dinocerata. This is divided in front by an elevated sagittal crest. The brain cavity is very small. There is a preglenoid crest.

Measurements: Length of true molars .031; diameters of Pm. IV, anteroposterior .010, transverse .012; do. of M. II, anteroposterior .011, transverse .016; do. of M. III, anteroposterior .008, transverse .015; elevation of occipital crest .058.

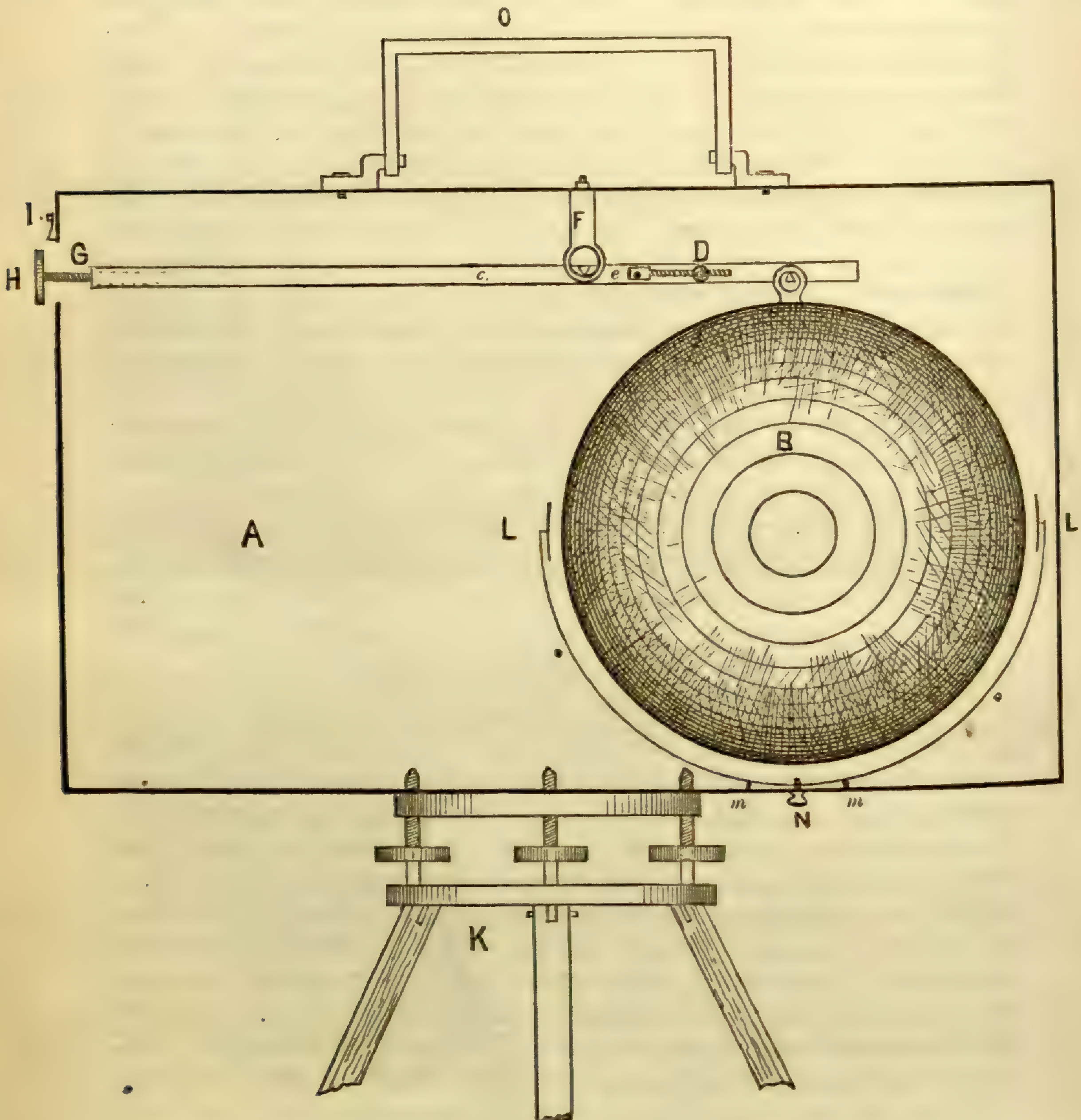
Phenacodus puercensis Cope.

Periptychus coarctatus Cope.

A BAROMETER FOR MEASURING SEPARATELY THE WEIGHT AND PRESSURE OF THE AIR.—The present mercurial barometer at all times measures, not alone the weight or pressure of the air, but both weight and pressure. It cannot measure either separately, that is, we cannot *know* when either pressure or weight alone has affected it. It is the purpose of this article to suggest a barometer that will measure alone the weight of the air and not be at all influenced by pressure, temperature, moisture or the sun's or moon's attraction. The central idea of this plan is not new, but the special construction to accomplish the end sought, I think, is.

Take a hollow glass sphere (*B*, as shown in the figure) and exhaust the air (by means of mercury or otherwise). Suspend it from one end of a balance beam, *c*. Put the whole in a glass walled box, *A*. Such box may be mounted on a tripod, *K*, with leveling screws. Into the opposite end of the balance beam, *c* (from the sphere) is inserted a screw, *G*, with threads measuring one hundredth of an inch, with a large circular head, *H*, graduated into divisions of one-tenth of its outside circumference,

which in connection with a vernier, *I*, will read to tenths of these or one hundredth of the circumference, or, as a whole, to one ten-thousandth of an inch. *H*, or the head of the screw, extends through a hole in the glass box, so as to be turned by hand. To the right of the fulcrum, *F*, is a screw, *e*, on which a ball, *D*, works, and is for the purpose of adjusting the balance at mean



sea-level. When this is done the screw, *G*, is run in or out as the case may be to measure the increase or decrease of the weight of air. The screw, *G*, might be made to carry a vernier along the balance bar, *c*, to register the number of turns of the screw, but such is not shown in this sketch. *O* is a handle for carrying the box by hand. *m m* are fulcrums on which a spring bow, *o o*, rests.

On the ends of this bow are two clamps, *L L*, for holding and steadying the sphere, *B*, when being moved or carried from place to place. The clamp screw, *N*, is turned so as to draw downward the bow, *o o*, between the fulcrums, *m m*, which causes the upper ends of the bow to clamp the sphere. Four clamps may be used.

I think it will be plain to any one that the *presence* of the air, or the attraction of the earth, sun or moon will be equally exerted on the sphere, *B*, and the balancing weight (screw *G*). Also, that the difference in the weight of the sphere, *B*, before the air is exhausted and afterward, is the weight of the air exhausted. Also, that the difference in the turn of the screw, *G*, from its position at sea-level, and any tried elevation above, to balance the sphere, is the comparative weight of the air at the two places.

If experience should prove that the accumulation of dust and moisture on the sphere, *B*, will materially affect the weight thereof, it can be obviated by balancing the sphere, *B*, with another of the same surface and weight (exhausted air excepted), which can be moved to the right or left on the left end of the balance beam, *c*, by means of a screw similar to *G*, and have the number of turns recorded by a vernier on the balance beam.

I have seen the mercurial barometer affected by the sudden opening or closing of a door in a tight room where the barometer was hung. I think I was not mistaken when I thought I saw it vibrate with the sudden dashing March winds which are strong enough sometimes to stagger a man as he walks. The plan I suggest will not be affected by these conditions if kept out of the wind current. It will be interesting to compare its action with the mercurial barometer anyway.—*Jno. T. Campbell, Rockville, Ind., Jan. 24, 1885.*

THE ERIBOLL CRYSTALLINE ROCKS.—*Nature* contains two lengthy articles upon the crystalline rocks of the Scottish highlands, the one from the pen of Archibald Geikie, the other a report by B. N. Peach and John Horne. It appears a fresh element of difficulty has been introduced into the geology of the Highlands. The crystalline schists which in Northwest Sutherland overlie fossiliferous Silurian strata, and which were believed by Murchison to be newer than those strata, are actually older, and overlie the newer rocks by virtue of reversed faults accompanied by "thrust-planes" or horizontal pushings forward of the rocks on the up-throw side. The coast sections of Loch Eriboll show these dislocations clearly. Beginning with gentle foldings they increase until the order of the strata is reversed. In Durness, for example, the overlying schists have been thrust over westwards across all the other rocks for at least ten miles. Some of the overlying bands are Archæan gneiss, others Silurian quartzite, and in one case a mass of the Upper

Durness limestone can be detected. The crystallization increases, however, so much that it becomes impossible to determine the original character of the rock by examination in the field. From the remarkably constant relation between the dip of the Silurian strata and the inclination of their reversed faults, Professor Geikie concludes that these dislocations took place before the strata had been seriously disturbed.

THE THEATER OF THE EARTHQUAKES IN SPAIN.—M. Hébert recently presented to the French Academy of Sciences a communication upon the earthquakes in the south of Spain—cataclysms more violent than any which have visited Spain in historic times. If the details furnished by the papers are examined, it will be evident that the localities recently disturbed by earthquakes are almost all situated on two zones, the one to the south of the Jurassic and Cretaceous mass which bounds the provinces of Malaga and Granada, the other to the north of it. In the southern zone the most severely visited localities were Antequera, Malaga, Velez, Torros, Alhama, Granada, etc.; while the northern zone comprehends Cadiz, Xerez, Seville, Cordova, Linares, etc., and Valencia, all towns where shocks have been felt. The rest of the peninsula does not seem to have suffered much from this instability of the Mediterranean regions, except Albuquerque in the parallel of Lisbon, destroyed Dec. 26th and 27th, and some slight shocks in Galicia. M. Hébert called attention to the Balearic isles, which are situated between the two zones, are elevated eighty meters or more above the sea-level, and are composed at the surface of horizontal beds of Quaternary age. These islands have therefore been raised more than a hundred meters since the Quaternary epoch, and this elevation has been limited northward and southward by fractures in the line of prolongation of the defined zones of dislocation above. Thus it is clear that the cause of dislocations in these regions is always present and always active.

GEOLOGICAL NOTES.—*General.*—A letter from Capt. C. E. Dutton upon the basalt fields of New Mexico, has been contributed to *Nature*. The center of activity is Mount Taylor, otherwise the San Mateo mountains, a volcanic pile 11,380 feet high, carved into numerous spurs by magnificent gorges. It was originally built by outbreaks both from its flanks and summit. From this center the lavas reach out for forty-five miles to the north-northeast, and in other directions for from eighteen to thirty miles. Beyond the immediate base of the mountain the lava forms a superficial sheet over each mesa or table, varying in thickness from fifty to two hundred feet. Erosion has cut through the lava and the underlying sedimentary strata, leaving mesas sometimes separated two or three miles from the parent mass. Many of the vents scattered around the flanks of Mount Taylor can be easily

identified. The "necks" or "chimneys" which are left standing in the valley plains beyond the farthest verge of the lava-capped mesas form one of the most striking features of the country. One is nearly two thousand feet high. In the wide valley-plains between the mesas are newer fields of lava, some so fresh that one might think them scarcely a century old, and it is clear that they were erupted after many a square mile of strata overflowed by the older basalts had been eroded away. No vents are found in connection with these younger eruptions, nor have any scoriæ been discovered. Some of them seem to have flowed from small depressed cones at their upper ends. One stream is sixty miles long. The ejecta found in connection with the older basalts are in relatively small quantity. Cliffs, mesas, terraces, carved buttes and gorgeous colors are as characteristic of the New Mexico plateau region as of that of Utah, and the Cretaceous system is better preserved. The younger basalt is much like the rougher lava of Mauna Loa.——As a conclusion of his studies upon the origin of phosphates of lime in sedimentary formations M. Dieulafait announces that the waters which have excavated the calcareous rocks of the north-west of France, and formed the phosphorites, are *exterior* waters circulating from above downwards. It thus follows that, contrary to current ideas, deposits similar to those of which the phosphorites form part, wherever found, and whatever their importance, do not owe their origin to internal but to external causes.

Silurian.—A fossil scorpion has recently been found by M. Lindstrom in the Upper Silurian of the Island of Gothland (Sweden). The surface is so well preserved that the chitinous cuticle, compressed and wrinkled by the superincumbent beds, can be made out. The cephalothorax, abdomen with its seven dorsal plates, and tail of six segments ending in the poison-bearing sting, can be well distinguished. One of the stigmata can also be seen. M. Lindstrom has named this oldest of known land animals *Palæophones nuncius.* The four pairs of thoracic feet in this scorpion are like those of the embryos of many other Tracheata and resemble those of Campodea. The same appendages in the Carboniferous scorpions are like those of existing species.

Cenomanian.—The Elobi islands, upon the west coast of Africa and in the first degree of north latitude, are formed of horizontal beds of sandstone, poor in fossils. One of the species met with, *Schlönbachia inflata*, characterizes the Lower Cenomanian of Europe, and is particularly abundant in the French departments of Yonne and Aube. These beds, according to M. Ladislos Szajnocka, are continued along the Gaboon coast to the islands of Muni and Mounda, and appear also to stretch along the west coast of Africa along the Sierra da Crista and the Sierra Camplida to Mossamedes and Benguela.

MINERALOGY AND PETROGRAPHY.[1]

RECENT TEXT-BOOKS OF MINERALOGY AND PETROGRAPHY.—The appearance of the second edition of Professor E. S. Dana's well known Text-book of Mineralogy,[2] containing over fifty pages of new matter in the form of supplementary chapters, brings this admirable introduction to the science fully up to date, as well in respect to its treatment of the newest methods and apparatus for mineralogical investigation as in the completeness of the list of species mentioned.

Professor Gustav Tschermak's excellent Lehrbueh der Mineralogie, completed only near the end of 1883, fills the same place ni the German language that Dana's text-book does in English, and fills it so well that a second revised edition has already appeared,[3] having the imprint 1885. This work is especially strong in its treatment of the physical, particularly the optical, properties of minerals, as well as their modes of origin and occurrence. Considerable space is also devoted to their chemical relations, and an attempt made to classify them according to a scheme based somewhat on the periodic arrangement of the elements. The description of the species is, however, often too meager even for a textbook, many important minerals being mentioned only by name.

Professor A. de Lapparent, of Paris, author of the recent Traité de Géologie, has also just issued a mineralogical manual entitled Cours de Minéralogie.[4] A large proportion of this work is devoted to the treatment of crystallography, in which the cumbersome system of notation suggested by Haüy and developed by Lévy and Des Cloizeaux, is retained, as indeed it is in nearly all French works on mineralogy. The arrangement of the species is merely in accordance with the frequency of their occurrence. In other words the classification is purely geological, and it is among geologists that the work will probably prove to be of the greatest use.

The second volume of Hilary Bauerman's Mineralogy,[5] devoted to the description of species, is very unsatisfactory. Much that is very important, especially many results of the best recent mineralogical work, has been altogether disregarded, and the author conveys the impression of being by no means thoroughly acquainted with the newest methods or the latest discoveries in the science of which he treats.

Dr. Heinrich Baumhauer, well known for his researches on the figures artificially etched on crystal planes by chemical reagents

[1] Edited by Dr. GEO. H. WILLIAMS of the Johns Hopkins University, Baltimore, Md.

[2] Text-book of Mineralogy, new and revised edition, 1883 (Wiley & Sons).

[3] Lehrbuch der Mineralogie. Zweite verbesserte Auflage. Wien, 1885.

[4] Cours de Minéralogie. Par A. de Lapparent. 8vo, pp. 560, 519 cuts and one colored plate. Paris (Savy) 1884.

[5] Text-book of descriptive Mineralogy. Text-books of science series. 1884.

and their relation to the symmetry of the crystal, has just published a short text-book of mineralogy,[1] which, however, is very elementary in its character, being intended only for use in high schools or for the self-instruction of beginners.

Dr. Aristides Brezina, of the University of Vienna, has published the first part of an elaborate and exhaustive series of crystallographic researches, undertaken in competition for a prize offered by the Royal Academy of Science.[2] The first part, although covering over 350 octavo pages, deals only with methods of investigation, and constitutes a most valuable addition to the works on mathematical crystallography.

Fr. Ulrich, of Hanover, is the author of a quarto pamphlet, containing sixteen pages, covered with figures to illustrate the relations of the crystalline forms of the different systems, the development of hemihedral forms and some characteristic combinations of common minerals.[3] Many of the figures are colored. and, while roughly executed, they are useful in making plain to beginners some of the more elementary principles of crystallography. No printed explanations are appended.

A much-needed elementary text-book of microscopical mineralogy has very recently appeared, by Dr. Eugen Hussak, of Gratz.[4] Only such species are treated as enter into the composition of rocks, and these almost exclusively in reference to their appearance and the methods of their identification in thin sections under the microscope. The first part of the book deals with the methods of microscopical petrography—the construction of the microscope and the manner in which the optical properties of minerals are used for their identification; the method of separating rock constituents by means of a heavy solution, microchemical analysis and some of the most peculiar characteristics common to all minerals when examined in thin sections. The second part contains the distinguishing microscopic peculiarities of each rock-forming species arranged in tables, as is the case in Professor Brush's manual of Determinative Mineralogy. These are sometimes too concise to be satisfactory, but they nevertheless contain a great amount of information in a very small space. The means of distinguishing similar minerals are especially emphasized. A valuable list of references to the more important microscopic studies of different rock-forming minerals, arranged alphabetically, is annexed to these tables. The book is not a text-book of petrography, since rocks themselves are not described, but

[1] Kurzes Lehrbuch der Mineralogie einschliesslich der Petrographie. Von H. Baumhauer. 8vo, pp. 190. Freiburg, 1884.

[2] Krystallographische Untersuchungen an homologen und isomeren Reihen. Von Dr. A. Brezina. 1 Theil, Methoden. Wien, 1884. 8vo. pp. 359.

[3] Krystallographische Figurtafeln zum Gebrauche bei mineralogischen Vorlesungen. Von F. Ulrich. Hanover, 1885.

[4] Anleitung zum Bestimmen der gesteinbildenden Mineralien. Von Dr. E. Hussak. Leipzig, 1885, pp. 196.

rather an extension of the ordinary works on mineralogy. Although quite elementary, it will prove very valuable to those commencing work in microscopical mineralogy, to whom the vast amount of material contained in the larger manuals is often discouraging.

CROCIDOLITE FROM THE CAPE OF GOOD HOPE.—Considerable interest attaches to that fibrous stone with a rich yellowish-brown luster, which is beginning to find so wide an application in the arts, especially for the manufacture of small ornaments, and which jewelers generally designate as crocidolite. In its structure it much resembles the well-known "catseye," and when properly cut it can scarcely be distinguished from this except by its color, a fact which frequently causes it to be called "tiger's eye." The true crocidolite is an asbestiform hornblende, possessing a blue color, like its more compact equivalent glaucophane. Among other localities it occurs abundantly near the Orange river in South Africa, from which place specimens were analyzed by Klaproth[1] as early as 1815, and again by Hausmann and Stromeyer[2] in 1831. The latter authors gave it the name crocidolite in allusion to its fibrous structure (*κροκίς*, a woof). The occurrence of this mineral in Africa has been described by Cohen[3] and Stow.[4] The former says that a range of mountains extends in N. N. E. direction from the Orange river through the province of West Griqualand, the central part of which is known as the Asbestos mountains. Here the crocidolite occurs in veins from one to six inches in width, together with vast quantities of jasper and other forms of silica. Sometimes the crocidolite is pure and is then blue in color, soft, and easily separable into the finest fibers; more often, however, it is more or less decomposed and to a greater or less extent replaced by quartz. It is upon this alteration and replacement that the commercial value of the mineral depends. The yellowest specimens are most changed and owe their color to the almost complete oxydation of the iron. Wibel[5] studied the mineral in 1873 and concluded that it was a complete pseudomorph of quartz after crocidolite, only the iron of the original mineral being left in the form of göthite. Renard and Klement[6] have recently contributed an exhaustive paper on the subject. Analysis of the yellowest variety gave:

SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	H_2O
85.05	4.94	0.66	0.44	8.26	0.76

Total 100.11

[1] Chemische Abhandlungen gemischten Inhalts, 1815, pp. 233–242. Beiträge, VI, p. 237, 1815.

[2] Götting'scher gehl. Anzeiger, II, 1831, p. 1585.

[3] Neues Jahrbuch für Min., etc., 1873, p. 52.

[4] Quarterly Journal Geol. Soc., XXX, p. 622.

[5] Neues Jahrbuch für Min. etc., 1873, p. 367. (H. Fischer proved the same was the case for many varieties of catseye.—Tschermak Min. Mittheilungen, 1873, p. 117.)

[6] Bull. d. l'Acad. Roy. d. Sciences de Belgique (3), VIII, 1884, 530–550.

Analysis of the more greenish or bluish kind gave:

SiO_2	Fe_2O_3	FeO	Al_2O_3	CaO	MgO	H_2O
93.43	2.41	1.43	0.23	0.13	0.22	0.82

Total 98.67

They announce it as the result of a microscopic examination that the mineral is not a pseudomorph, but that the silica has been deposited between the fibers, which were already more or less altered, enclosing them in a hard transparent matrix.

PETROGRAPHICAL NOTES. — Becke[1] gives, in good form, the methods for microscopically distinguishing augite and bronzite. ——Scharizer, of Vienna, has studied the hornblende from Jan Mayen, and appends some interesting remarks regarding the general chemical constitution of the aluminous hornblendes.[2] He regards them as isomorphous mixtures of typical actinolite $(Mg\ Fe)_3\ Ca\ Si\ Si_3\ O_{12}$ and a molecule $\dot{R}_3\ \dot{R}_2\ Si_3\ O_{12}$, to which he applies Breithaupt's old name, syntagmatite.——Merian contributes an interesting attempt to trace the relation between the composition of an eruptive rock and that of the pyroxene mineral which it contains.[3]——J. Eliot Wolff gives a short note on the occurrence of nephelinite and nepheline-tephrite, both rich in a mineral of the sodalite group and often containing olivine, in the Crazy mountains, an isolated range north of the Yellowstone river, in Montana.[4] These rocks have never before been observed within the limits of the U. S.——Very interesting is the discovery, by J. S. Diller, of a new type of volcanic rock—a hypersthene basalt—on Mt. Thielson, Oregon,[5] on the surface of which fulgurites were found to be largely developed. This rock is new, but exactly fills a vacancy in the accepted rock classification.—— The same writer mentions peridotites which break through the Carboniferous strata of Kentucky in the form of dykes, enclosing fragments of the adjacent rock. He also finds, upon microscopic examination, that the rock of the new volcano on Bogosloff island, near Alaska, is a hornblende-andesite.[6]——Renard has given an elaborate microscopic study of the volcanic and cosmic dust that forms so large a portion of the deepest ocean deposits.[7] ——Holst and Eichstadt[8] have described from Slättmossa, in Sweden, an amphibole granite having a beautiful spherulitic structure not inferior to that of the well known "napoleonite" or "corsite," a nodular diorite from Corsica, described by Vogel-

[1] Tschermak Min. Pet. Mittheilungen, v, 1883, p. 527.
[2] Neues Jahrbuch für Min, etc.. 1884, II, p. 143.
[3] Ib., III Beil. Band, p. 252, 1885.
[4] Ib., 1885, I, p. 69.
[5] *Amer. Jour. Science*, Oct. 1884, p. 253.
[6] *Science*, V, pp. 65 and 66, Jan. 23, 1885.
[7] Bull. Mus. Roy. d'Hist. Nat. d. Belgique, III, 1884, 1–24. *Nature*, April 17, 1884.
[8] Geol. Fören. i. Stockholm Förh., 1884, Vol. VII, p. 134.

sang (Niederrhein. Gesell. für Natur-und Heilkunde, 1862). A similar diorite has been mentioned by Reinhold[1] as occurring in Placer county, Cal. (vid. NATURALIST, 1882, p. 610).——Michel-Lévy[2] has established seven different types of volcanic rock occurring in and near Mont Dore, in Central France. They include domite, cinerite, trachyte, andesite, phonolite and basalt.

BOTANY.[3]

HYBRIDIZATION OF POTATOES.—During the past year some experiments were made at Reading, England, upon the grounds of Messrs. Sutton & Sons, the eminent potato growers. Under the advice of Mr. J. G. Baker the attempt was made to secure a hybrid between the common potato and the Darwin potato (*Solanum maglia*) from the southern part of South America. The experiment is reported as having been successful, and we may look ere long for the tubers of this new form. "Every gardener and farmer may now welcome the birth, so to speak, of a hybrid which we may hope will enable the potato plant to resist the attack of parasites, and especially of those of the devastating fungus, *Peronospora infestans.*"

HETEROECISM OF CEDAR APPLES.—Dr. Farlow has been studying the cedar apples (species of Gymnosporangium) with a view to determining whether the cluster cups (species of Rœstelia) of the apple (Pirus), hawthorn (Cratægus) and June-berry (Amelanchier) are stages of the fungus which occurs on species of cedars (Juniperus). In a recent paper read before the American Academy of Arts and Sciences, the results of a series of experiments are given, the general bearing of which is in favor of the doctrine of heteroecism. After discussing the difficulties and the objections which may be raised, the author says that "the conclusions to be drawn are, that:

"1. The æcidium of *Gymnosporangium biseptatum* is probably *Rœstelia botryapites* [on Amelanchier].

"2. The æcidium of *G. globosum* (to be kept distinct from *G. fuscum*) is possibly *Rœstelia aurantiaca* [on *Cratægus oxycantha*].

"3. The æcidium of *G. macropus* is to be sought among the Rœsteliæ growing especially on apples and Amelanchier."

NORTH AMERICAN FORESTS.—The North American continent, or that part of it situated north of Mexico, may be conveniently divided, with reference to its forest geography, into the Atlantic and the Pacific regions by a line following the eastern base of the Rocky mountains and its outlying eastern ranges from the Arctic circle to the Rio Grande. The forests which cover these two divisions of the continent differ as widely in natural features, composition

[1] Proc. Philad. Acad. Nat. Science, 1882, p. 59.

[2] *Comptes Rendus*, T. XCVIII, 1884, p, 1394.

[3] Edited by PROF. C. E. BESSEY, Lincoln, Nebraska.

and distribution, as the climate and topography of Eastern America differ from the climate and topography of the Pacific slope. The causes which have produced the dissimilar composition of these two forests must be sought in the climatic conditions of a geological era earlier than our own and in the actual topographical formation of the continent.

The forests of the Atlantic and the Pacific regions, dissimilar in composition in the central part of the continent, are united at the north by a broad belt of sub-arctic forests, extending across the continent north of the fiftieth degree of latitude. One half of the species of which this northern portion is composed, extends from the Atlantic to the Pacific; and its general features, although differing east and west of the continental divide, in conformity with the climatic conditions peculiar to the Atlantic and the Pacific sides of the continent, still possess considerable uniformity. The forests of the Atlantic and the Pacific regions are also united at the south by a narrow strip of the flora peculiar to the plateau of Northern Mexico, here extending northward into the United States. Certain characteristic species of this flora extend from the Gulf of Mexico to the shores of the Pacific, and while the peculiar features of the eastern and the western slopes of the interior mountain system of the continent are still maintained here, the Atlantic and the Pacific regions of the Mexican forest belt possess many general features in common. Typical North American species, moreover, peculiar to the forests of the Atlantic or of the Pacific, mingle upon the Black hills of Dakota and upon the Guadalupe and other mountains of Western Texas, the extreme eastern ridges of the Rocky Mountain range and the outposts between the Atlantic and the Pacific regions.—*Professor Sargent in Vol. ix of the 10th Census of the United States.*

THE FERTILIZATION OF THE LEATHER-FLOWER (CLEMATIS VIORNA).—The leather-flower is a rather curious plant, climbing by means of its leaf-stalks among the low underbrush. The flower (Fig. 1) it bears is bell-shaped and hangs pendent from a somewhat long peduncle, which extends in a horizontal direction. It has no petals; four sepals taking their place. These are very thick and leathery, and are colored purplish without. The edges and inner part of the sepals are white. The tips are recurved, and these, together with the white edges of the sepals, perhaps serve as guide marks, directing the insect to the entrance below as a means of obtaining the honey. The bee, which I find to be the fertilizing agent, holds to the recurved tips of the sepals while effecting its honey-gathering, and this is the more obvious purpose of these tips. The outer stamens begin to open first, then those next within, being in advance of the pistils.

But before the inner stamens are ready to shed their pollen, the stigmas are also ready, so that were it not for a very ingenious

arrangement, pollination would easily take place. The back of the anthers and the entire surface of the little tips extending above them are hairy. So are likewise the styles (Fig. 3). The calyx is closely contracted at its opening, pressing together the numerous stamens and pistils into a compact mass. Owing to the greater size of the pistils, the stigmas extend beyond the anthers (Fig. 4), and since the close packing brings the hairs on the

Fig. 1.

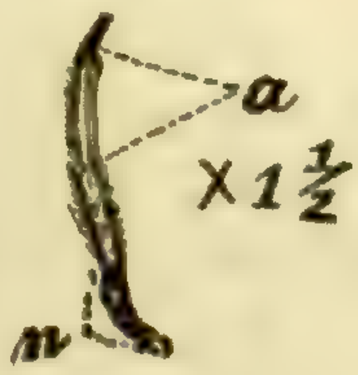


Fig. 2.

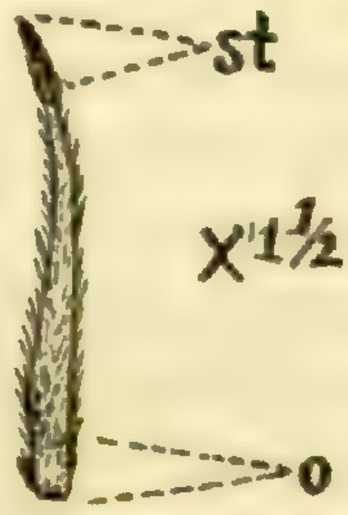


Fig. 3.

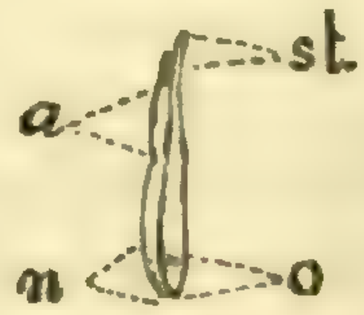


Fig. 4.

FIG. 1.—A flower, natural size. FIG. 2.—A stamen enlarged 1½ times; *a*, the anther; *n*, the nectary. FIG. 3.—A pistil enlarged 1½ times; *o*, the ovary; *st*, the stigma; FIG. 4.—A pistil and a stamen about natural size, showing relative length.

anthers into play, the pollen does not escape. But at a later period the pressure of the sepals relaxes, the stamens are looser, and self-fertilization is not absolutely impossible, but certainly unnecessary, judging by the frequent visits of bees. The insertion of the bee's proboscis releases the pollen, which falls upon the abdomen and thorax, to be left upon the more prominent stigmas of the next blossom. The nectary is at the base of the filament.—*Aug. F. Foerste, Granville, Ohio.*

PLANT MIGRATIONS.—Fifteen years ago there were no dandelions in the Ames flora (in Central Iowa), now they are very abundant, and have been for half a dozen years. Then there were no mulleins (*Verbascum thapsus*), now there are a few. Then the low and evil-smelling *Dysodia chrysanthemoides* grew by the roadside in great abundance, now it is scarcely to be found, and is replaced by the introduced "dog-fennel" (*Anthemis cotula*). Then the small fleabane (*Erigeron divaricatum*) abounded on dry soils, now it is rapidly disappearing. Then no squirrel-tail grass (*Hordeum jubatum*) grew in the flora, now it is very abundant, and has been for ten years. Then there was no bur-grass in the flora, now it is frequently found, and appears to be rapidly increasing. Both of these grasses have apparently come in from the west and north-west. Fifteen years ago the low amaranth (*Amarantus blitoides*) was rather rarely found; now it is abundant and has migrated fully 150 miles north-eastward. This plant has certainly come into the Ames flora from the south-west within the last twenty years.

In Nebraska, I am informed by the old settlers, that there have been notable migrations of plants within the past twenty or thirty years. The buffalo grasses of various kinds were formerly abun-

dant in the eastern part of the State, now they have retreated a hundred to a hundred and fifty miles, and have been followed up by the blue-stems (Andropogon and Chrysopogon). The blue-stems now grow in great luxuriance all over great tracts of the plains of Eastern Nebraska, where twenty years ago the ground was practically bare, being but thinly covered by buffalo grasses. In Dakota it is the same, the blue-stems are marching across the plains, and turning what were once but little better than deserts into grassy prairies.—*Charles E. Bessey.*

GRAY'S BOTANICAL CONTRIBUTIONS, 1884–'85.—These occupy fifty-four pages of the Proc. Amer. Acad. Arts and Sci., and bear date of January 26, 1885. There are four parts, as follows: I. A revision of some Borragineous genera. II. Notes on some American species of Utricularia. III. New genera of Arizona, California and their Mexican borders, and two additional Asclepiadaceæ. IV. Gamopetalæ Miscellaneæ.

In the first section, after a discussion of various structural points, a revision of the Eritrichieæ is proposed which suppresses the genus Eritrichium (the name however being retained for a section of Omphalodes). The species are distributed among the genera Omphalodes, Krynitzkia, Plagiobothrys and Echidiocarya. In the second section certain obscurities in connection with the synonymy of species of Utricularia are cleared away. In III the new genera are Veatchia (Anacardiaceæ), Lyonothamnus (Rosaceæ?), Pringleophytum (Acanthaceæ), Phaulothamnus (Phytolaccaceæ), represented by an interesting but uncomely shrub (*P. spinescens*) from N. W. Sonora, Himantostemma (Asclepiadaceæ), and Rothrockia (Asclepiadaceæ), the last dedicated to "my friend and former pupil, Dr. J. Trimble Rothrock, professor of botany in the University of Pennsylvania, at Philadelphia, a keen botanist and zealous teacher, an explorer both in Alaska and Arizona, author of a sketch of the Flora of Alaska, and of the botany of Wheeler's report upon the U. S. Surveys of Arizona and Southern California, and whose name it is well to commemorate in an Arizono-Mexican genus."

In Section IV the most important accession of species is a second Schweinitzia, viz., *S. reynoldsiæ*, discovered by Miss Mary C. Reynolds near St. Augustine and on the Indian river, Florida. —*Charles E. Bessey.*

BOTANICAL NOTES.—The second number of the Bulletin of the Washburn College Laboratory of Natural History (Topeka, Kansas) contains descriptions of a number of new species of fungi, among which are two Phalli, viz., *Phallus collaris* and *P. purpuratus*, the first illustrated by several figures. *Simblum rubescens*, the curious plant of abominable odor and strange distribution, first described by Gerard in the *Torrey Bulletin*, is recorded as common in Shawnee county. The Kansas form is set off (with-

out sufficient reason, as it appears to us) as the variety *kansensis*. *Lycoperdon rubro-flavum*, *L. sigillatum*, *L. rima-spinosum*, *L. tabacinum* (the last by J. B. Ellis) and *Geaster turbinatus* are other new species of Gasteromycetes. Lists of ferns, mosses, lichens, algæ and parasitic fungi complete this very interesting bulletin. ——Part II of the Catalogue of Canadian Plants, by John Macoun, is a thick pamphlet of about 200 pages, devoted to the Gamopetalæ. Curiously the number of species in this part (908) is almost exactly the same as in the previous one, viz., 907. There is a great deal of exceedingly valuable information given upon the geographical range of species, and also much in the way of notes upon habitats.——Dr. Gray's memorial of George Bentham in the *American Journal of Science* for February, contains one of the fullest accounts of the very full life of the venerable botanist, whose death the world still mourns. "His life was a perfect and precious example, much needed in this age, of persevering and thorough devotion to science while unconstrained as well as untrammeled by professional duty or necessity. For those endowed with leisure, to 'live laborious days' in her service, is not a common achievement."——Nos. 1 and 2 of the *Journal of Mycology* have been received, and we can only say at this time that the matter is, in the main, good, but that the editor has not yet succeeded in getting from his printers as good work as is desirable. This, however, will doubtless be improved in the future.

ENTOMOLOGY.

GENERIC POSITION OF POLYDESMUS OCELLATUS.—In a letter to Professor Packard the undersigned writes as follows:

In the AMERICAN NATURALIST, April, 1883, you have published a paper on "a new species of Polydesmus with eyes," which you have called *Polydesmus ocellatus*. As can be seen from your description given there, the new myriopod must be a species of the genus Craspedosoma Leach (Transac. Linn. Society, Vol. XI, p. 380, printed 1815), and not of the genus Polydesmus Latr.; for the latter genus is always characterized by the want of eyes and by the number of segments being twenty, whereas the former genus is characterized by oculi composed by multiseriated ocelli and by the number of segments being thirty or, in younger specimens, less, from twenty-seven to twenty-nine.

In consequence of the necessity of ranging your species in another genus, all the members of which are provided with eyes, the specific name *ocellatus* should be removed and another introduced instead of it. I propose the name *Craspedosoma packardii*.

As I have reason to suppose, you are probably not in possession of Dr. Fr. Meinert's paper on the Chilognatha of Denmark (Danmark's Chilognather, published 1868 in the Naturhistorisk Tidsskrift, 3 Række [= series], 5th Vol.), where the genera Poly-

desmus and Craspedosoma are very well defined. The characteristics given by that excellent author are, in extenso, as follows:

"*Polydesmus*.—Mandibulæ pectinibus senis, pro dente molari lobo fimbriato instructæ. Lamina labialis maxima, tertiam partem stipitum labialum et maxillarium sejungens. Stili linguales bidentes. Oculi nulli. Antennæ articulo penultimo breviore quam primo; tertio longissimo, longiore quam sexto. Stigmata odorifera in segmento 5, 7, 9, 10, 11, 13, 15–19 sita. Segmenta strictura transversa partita; pars posterior lateribus valde explanata. Segmentum 2–4 singulo pare, cetera segmenta binis paribus pedum instructa; numerus segmentorum 20. Sterna duo prima libera; cetera per paria inter se et cum segmentis suis concreta. Segmentum secundum et tertium infra clausa. Pedes omnes 6-articulati; articulus ultimus longissimus, longior quam tertius. Valvulæ anales valde convexæ. Corpus non contractile. Mas: Par prius pedum segmenti septimi in organa copulationis prominentia conformatum. Paria pedum 30. Femina: Paria pedum 31.

"*Craspedosoma*.— Mandibulæ pectinibus denis; dente molari magno. Lamina labialis magna, tertiam partem stipitum labialium modo sejungens. Stili linguales tridentes. Oculi ocellis multiserialis. Antennæ articulo penultimo longiore quam primo; tertio longissimo, longiore quam quinto. Stigmata odorifera nulla. Segmenta strictura transversa partita; pars posterior plus vel minus dilatata. Segmentum secundum, tertium ultimumque pediferum singulo pare cetera segmenta binis paribus pedum instructa; numerus segmentorum 30 vel minor. Sterna omnia libera. Pedes primi et secundi paris 6-articulati, ceteri 7-articulati; articulus pedum quartus longissimus, longior quam ultimus. Valvulæ anales angulatim convexæ. Corpus in turbinem vel spiram contractile. Mas: Segmentum sextum leviter, septimum valde efflatum. Utrumque par pedum segmenti septimi in organa copulationis obtecta conformatum. Paria pedum 48 vel pauciora. Pedes, paribus primo, secundo ultimisque exceptis, articulo ultimo dense pulvillato. Femina: Paria pedum 50 vel pauciora."

If you should wish, for comparison, specimens of the Swedish *Craspedosoma rawlinsii* Leach, I request the honor of receiving your orders, and immediately some individuals will be sent to you.—*Dr. Anton Stuxberg, director of the Zool. Mus. of Gothenburg, Sweden.*

[We have delayed publishing this note hoping to receive the specimens of Craspedosoma, in order to ascertain whether we have made a mistake in referring the myriopod to Polydesmus, but thus far it has not been received.—*A. S. P.*]

AQUATIC CATERPILLARS.—*Apropros* of our article on the habits of the aquatic caterpillar of Hydrocampa in the NATURALIST for August last, we copy the following account of one of the same group of Pyralids from the Journal of the Royal Microscopical Society for December:

W. Müller-Blumenau has examined *Cataclysta pyropalis*, the larvæ of which live in water, but do not resemble the only known example, *Paraponyx stratiolata*, in the same way of breathing by gills. The larva, which is 1.4^{cm} long, has a flattened body, attenuated posteriorly. The gills are in the form of unbranched tubular appendages of the second and third thoracic and of all the abdominal segments; they are arranged in an upper and a lower group; the number of gills varies somewhat. The stigmata of the tracheal system are, as a rule, all closed, but are easily to be dis-

tinguished by a black oval dot; just as in other larvæ with tracheal gills, as described by Palmén, the stigmatic branches are completely closed. The larvæ are ordinarily found attached to stones, and are rather more frequent in stagnant than in running water. They form for themselves a chamber with delicate but closely spun walls, and they do not leave this, as a rule, until they attain to the imaginal state. The spaces at the edge of the cocoon only serve as a means of exit for the fæces; they live on the diatoms and other cellular Algæ which grow on the stones to which they attach themselves. They almost always fix themselves by their backs to the stones, and in correlation with this we observe that they present the remarkable condition of having their dorsal surface pale, and their ventral dark. This is not however, to be regarded as a protective adaptation, but as the result of an earlier condition in which the whole of the larva was darkly pigmented; the paleness of the back is due to the want of light.

After an account of the pupa and of the homes in which it dwells, the author passes to some other species of the same genus, all of which are Brazilian. These are much less common, and their specific characters are not yet fully worked out, but there are probably five species. The gills, which are always unbranched, never attain to the relative length seen in *C. pyropalis*, but they are always more numerous. The covering of the pupa contains air-spaces in its outer division, which are connected with that of the inner, but as the stones or algæ forbid any exchange of gas with the exterior, this can only be effected by the spaces in which the water is able to pass; this explains how it is that we sometimes find the air-chambers on the side of the house which is attached to the stone.

Organs of Hearing and Smell in Spiders.—F. Dahl proposes to classify spiders according to the character and disposition of the auditory hairs on the limbs of these animals, as follows:

1. Tibia with two series of auditory hairs, metatarsus with one hair, and tarsus with a rudimentary pit or depression free from hairs, *e. g.* Epeiridæ, Uloboridæ, Theridiidæ, and Pholeidæ.

2. Tarsus with no rudimentary depression for auditory hairs, usually bearing a number of hairs like the metatarsus and tibia, *e. g.* Territelariæ, Dysderidæ.

The remaining number of this class are further subdivided according to the presence of one or two series of auditory hairs on the tarsus. A single series is characteristic of Amaurobiidæ, Agalenidæ, Philodromidæ, Thomisidæ, and Attidæ. Two series occur in Drassidæ, Anyphoenidæ and Lycosidæ.

Dahl has satisfied himself that these auditory organs can appreciate not only sound, but also variations of atmospheric pressure, such as winds.

An olfactory organ is stated to exist on the maxillæ. On the surface in front of which the mandibles work to and fro is a soft

flat track, of a sieve-like appearance, beneath which occur a number of long, polygonal processes, apparently fused, but in reality separate, which are in connection basally with a stout nerve-filament. Rather by a process of exhaustion than from direct evidence as to their function, Dahl affirms that this organ is olfactory in nature. It is universally found in the Arachnida, though in different stages of development, being most fully developed in Pachygnatha.—*Journ. Roy. Microscopical Society, Dec.*

Ignivorous Ant.—G. Rafin described a species of ant which he has observed in the Island of St. Thomas, and which he proposes to call *Formica ignivora.* A large fire of wood having been kindled at a certain distance from the ant-hill, he is able to affirm that the ants precipitated themselves into it by thousands, until it was completely extinguished.—*Journ. Roy. Microscopical Society, Dec., 1882.*

Entomological Notes.—In a paper on the larvæ and larval cases of some Australian Aphrophoridæ, F. Ratte describes those of a species probably of Ptyelus, which are true shells, containing at least three-fourths of carbonate of lime, and resembling in shape some fossil and recent serpulæ, some being conical, others serpuliform or helicoidal. The conical shells are fixed on the branches of some species of Eucalyptus, the mouth turned upwards, the larva being placed in it with the head downwards.——In his notes on the flight of insects, Dr. v. Lendenfeld contests the views of the French physiologists that the position and movements of the wings of insects are merely the results of the mechanical influence of the resisting air, and gives instances where muscular contraction had been clearly proved.——Dr. S. W. Williston begins, in the Bulletin of the Brooklyn Entomological Society for February, a series of papers on the classification of North American Diptera. The first paper is extracted from a monograph of the North American Syrphidæ, now ready for the press, and which gives the results of a careful study of nearly 275 species of this family.——The committee on a union of *Papilio* with the *Bulletin* have reported in favor of it, and recommend that a monthly journal be issued under the name of *Entomologica Americana*, at $2 a year.—— An entomological society has been established at Newark, N. J.——In an examination of over 1500 specimens, Mr. C. H. T. Townsend found 115.3 males to every 100 females (*Can. Ent.*, Dec, 1884).——Mr. W. H. Edwards recounts, in the *Canadian Entomologist* for December, further experiments upon the effects of cold applied to chrysalids of butterflies.——*Nature* for Jan. 29, gives good figures and descriptions of the two fossil scorpions from the Silurian of Sweden and Scotland lately discovered.——A writer in the same number claims that the leaf-eating ant has something to do with the barrenness of the pampas of the La Plata, as they defoliate Eucalyptus plantations, cutting off the first leaves.

ZOOLOGY.

THE ANATOMY OF THE HIRUDINEA.—Mr. A. G. Bourne (Quart. Journ. Mic. Sci., July, 1884) contributes the results of observations upon ten genera of Hirudinea extending over a period of four years. His conclusions with regard to the vascular system are, that the whole of the vessels and sinuses are in continuity; that the lateral vessels communicate freely with one another without the intervention of any capillary system, that they possess branches opening into botryoidal or other capillary networks of the "cutaneous" system, and that they form nephridial capillaries and also capillaries upon the intestinal wall. The nephridial capillaries are partly collected again and carried to the capillaries of the cutaneous system, and partly unite to form a vessel which is connected with the perinephrostomial sinus. The dorsal sinus is directly connected with the ventral sinus, and both communicate with: (1) The cutaneous networks; (2) the capillary network upon the walls of the crop; (3) the capillaries upon the intestinal wall and the spiral valve; (4) the perinephrostomial sinuses. The botryoidal and other cutaneous capillary networks communicate with branches of the lateral vessel, and also with the extensions of the dorsal and ventral sinuses, of which the capillaries on the walls of the crop are developments. The vessels of the walls of the gastro-ileal tube are directly derived from branches of the lateral longitudinal vessels; the ventral sinus contains the nerve chain, the perinephrostomial sinus contains the nephridial funnel, and the network of capillaries on the testicular wall potentially contains the testis. The lateral vessels and their branches have a definite muscular wall, wanting only on their smaller branches and capillaries, but the dorsal and ventral sinuses, and the extensions in connection with them, containing organs, or forming a complete network around organs, have no muscular tissue in their walls. These latter, therefore, represent the "cœlom," while the lateral vessels and branches represent a vascular system which has not become quite closed.

The writer leaves unsettled the vexed question of the relationship of the leeches to other Vermes, but appears on the whole more inclined to approach them to the Platyelminths than to the Chætopoda.

NEUMAYR'S CLASSIFICATION OF THE LAMELLIBRANCHS.—Neumayr (Sitz. k. Akad. der. Wiss. Wien, 1883) gives a new classification of the lamellibranchs, founded upon the hinge. The oldest forms have no, or only the faintest, trace of hinge-teeth, the shells are thin, and there is usually neither mark of muscle or of pallial sinus. For these forms, supposed to have two equal adductor muscles and an entire mantle-line, the order Palæconchæ is proposed. From these are supposed to diverge the Desmodonta, without hinge-teeth or with irregular hinge-teeth, with

two equal adductor muscles and with a pallial sinus; and the Taxodontæ, with numerous undifferentiated teeth and two equal muscles. To the first of these groups belong the Pholadomyidæ, Corbulidæ, Myidæ, Anatinidæ, Mactridæ, Paphidæ, Glycimœridæ and Solenidæ?, and to the second the Arcidæ and Nucalidæ. The Tubicolæ form a suborder of the Desmodonta. From the Taxodonta branch off in one direction the Heterodonta, with distinct cardinal and lateral teeth fitting into each other and two muscle-impressions (Najadæ, Cardinidæ, Astartidæ, Crassatellidæ, Megalodontidæ, Chamidæ (Rudistes) (Tridacnidæ), Erycinidæ, Lucinidæ, Cardiidæ, Cyrenidæ, Cyprinidæ, Veneridæ, Gnathodontidæ, Tellinidæ, Donacidæ), and in another, the Anisomyaria, with irregular or no hinge-teeth, two unequal muscles or one only, and no pallial sinus. These form two suborders, Heteromyaria (Aviculidæ, Mytilidæ, Prasinidæ, Pinnidæ) and Monomyaria (Pectinidæ, Mytilidæ, Spondylidæ, Anomidæ, Ostreidæ). The Trigonidæ are considered a suborder of Heterodonta.

Antennary Gland of Cytheridæ.—W. Müller-Blumenau has discovered that *Elpidium brossliarum* is able to secrete a sticky material while in water; the observations made in connection with this discovery led him to the belief that the animal was able to spin, and that the spinning organ was placed in the second pair of antennæ. The organ so well known to be present at the base of this pair of appendages has been supposed to be poisonous in function, but no direct observations have ever been made in support of this view, and it is opposed by the delicate nature of its flagellum, which could never be supposed to be capable of inflicting a wound. When the animal is found hanging to glass its anterior end is always nearest to the glass, and the creature takes an oblique position. The author points out the difficulties presented by the habits of the animal in determining the question which he has investigated, but it would seem to be certain that the antennary gland is possessed of the power of secreting an attaching thread.—*Journ. Royal Microscopical Society, Dec.*

An Eyeless Eel.—Some years ago a very aristocratic house at Elizabeth was deserted because of the belief that it was haunted. Not long ago it passed into new hands. An old well was then uncovered, and the bottom cleaned. In doing this an eel (*Anguilla rostra*) some fourteen inches long and pretty thick for its length, was brought to the surface. It was quite blind, and in appearance to the ordinary observer was even eyeless. My wife and one of my sons saw it, and such was their opinion. —*S. Lockwood.*

Temperature and Hibernation.—In the January Naturalist (p 37), was an interesting article on the hibernation of the lower vertebrates. The author referred to hibernation as being in some

cases a voluntary act. Some of the observations on animals confined in our laboratory for the purpose of study, may throw more light on this subject. These animals are all well known species, and our aim is usually to keep them in surroundings as nearly like their natural habitations as possible. The temperature cannot, in the single room at present devoted to this use, be kept at a degree which will suit the habits of all of them, but the effects of its change on each is noted.

A number of frogs (*Rana halecina*) were placed in a closed glass case, with growing plants to study the balancing effect of their respiration. Plants and frogs seemed to thrive excellently, and during the four months trial, the temperature being kept at about 70° F., the latter showed no evident signs of hibernation, though the case stood in front of a window against which the snow was often falling. To observe the effect of a lower temperature, the case was moved to a cooler place (40°), and immediately the frogs, *using their front legs like dogs*, dug under the moss and stones, and remained out of sight until the former temperature was renewed. Similar experiments tried with salamanders, snakes, toads, houseflies and hornets, revealed at once a desire to hide during the lower temperature, but a complete absence of any such tendency when the normal degree of heat was preserved. In every one of these cases and a number of others, hibernation seemed to be forced. If the temperature was lowered, and they were at the same time prevented from burying themselves, they gradually became stiff and lifeless, but could in every case tried, except the last two mentioned above, be resuscitated upon the application of heat.

During this last fall a scorpion, shipped from the South in a bunch of bananas, was subjected to like treatment with the same results. When cold it was so helpless that it could be handled with impunity; but when its box was placed near the fire, it would dart about with elevated tail in the manner peculiar to itself.

With some of our animals experiments have given different results. A wood-tortoise, though given a warm corner near the fire, could not be persuaded to pass the winter above ground. It exhibited very evident signs of uneasiness as the snow came, and, as soon as material was furnished, burrowed out of sight. The same was true of a number of crayfish in our collection.

Not the least interesting among our pets is a pair of opossums (*Didelphys virginiana*). This animal is popularly believed not to go into winter quarters in this latitude; experiment thus far has shown that they remain in a semi-dormant condition, and take no food—a remarkable fact for opossums, when the conditions demand inaction. Their den was placed by a window on the north side of the building. Their food has remained untouched for more than a fortnight, and when viewed from the inside of the

window they are found to be curled up together in their straw nest. It may be that in this case "possuming" is only another word for hibernating.

All of our experiments lost a part of their value because the animals are in confinement; but, with the two exceptions given above, where habit controlled, all seemed to prove that hibernation is not an inherited and peculiar trait, but one that may be adopted when the conditions demand it. The NATURALIST shall hear of our further work in this direction.—*W. W. Thoburn (Laboratory of Illinois Wesleyan University).*

THE CHAMELEON VIVIPAROUS.—According to the newspapers a United States vessel recently arrived at Brooklyn which had taken on some animals at Capetown, Africa, among these was a female chameleon which during its passage gave birth to eleven young ones, all of which died.—*S. Lockwood.*

A CROW CRACKING CLAMS.—My son-in-law assures me that years ago it was not so rare to see, at Port Monmouth, the common crow (*Cervus americanus*) take a quahog (*Venus mercenaria*) up high in the air and drop it on a certain fence with a flat top-rail, thus cracking it. The sight has been witnessed by several persons. He was not able to say *how* the bird carried the bivalve, but it is supposable in its claws. It must have required nice calculating certainly.—*S. Lockwood.*

THE TURKEY BUZZARD BREEDING IN PENNSYLVANIA.—On May 20, 1882, I visited a "nest" of the turkey buzzard (*Cathartes aura* Illig.) in the lower part of Chester county, Pa. The locality was a deep wood bordering upon one of the tributaries of the Brandywine; the eggs, two in number, were deposited under a low, shelving rock, on the bare ground. The female bird was setting when I approached, but immediately flew off uttering a harsh "squak" and discharging a mouthful of carrion. She lit upon a dead tree near by, and remained there with her wings extended watching me. The male bird circled about over the wood but did not alight.

On May 22d of the same year I found another pair breeding in a similar situation on the farm of Mr. T. Dutton Steele, in East Bradford township, Chester county. The eggs in this case were laid on the ground at the foot of a large rock; they were longer than the others and not so thickly marked.

Several other "nests" were found during the same season, and in one instance the eggs were deposited in an old stump. The eggs were dirty white, spotted irregularly with reddish brown and purple.—*Witmer Stone, Germantown, Pa.*

A BEAVER DAM BUILT WITHOUT WOOD.—The idea that the beaver must have wood with which to build his dam is so universal that an exception to the rule seems worthy of record.

In September of 1883, near the headwaters of Beaver river,

Dakota, the writer discovered a dam freshly built of mud, and coarse, marshy plants. No trees or bushes could be seen anywhere in the vicinity. It was about twenty-five feet in length, thrown across a sluggish stream about half that width. Its level top was about four feet higher than the bottom of the channel. The dam was not more than half-filled with water.—*J. E. Todd.*

THE WILD HORSE OF THIBET.—The celebrated traveler, Przevalsky, on his return from his third great journey in Central Asia, brought to St. Petersburg an example of a new species of Equus. This was described in 1881 by Mr. J. S. Poliatow as *E. przevalsky*. It has warts on its hind-legs as well as on its fore-legs, and has broad hoofs. These characters ally it to the true horse, but the long hairs of the tail do not commence until about the middle of that appendage. It is thus intermediate between the horse and the asses, to which category the other known wild species of Equus belong. Its mane is short and erect, there is no forelock, and no trace of a dorsal stripe. The stature is small, the legs very thick and strong, the head large and heavy, and the ears smaller than in the asses. In color, it is whitish gray, paler and whiter beneath and reddish on the head, and on the upper part of the legs, which are blackish from the knee downward.

Przevalsky's wild horse inhabits the great Dsungarian desert between the Altai and Tianschan mountains. The Tartars call it "Kertag," and the Mongols "Statur." It goes in troops of from five to fifteen, led by an old stallion. It is lively, very shy, with sight, smell, and hearing well-developed, so that it is exceedingly difficult of approach. It seems to prefer the saline districts, and to be able to do without water for long periods. Thus it can only be hunted in the winter, when melted snow can be obtained. Przevalsky only met with two herds during his whole stay in the desert. The only specimen brought to Europe is in the museum of the St. Petersburg Academy of Sciences.

ZOOLOGICAL NOTES.—*Sponges.*—Professor W. S. Sollas has recently studied the development of *Halisarca lobularis* from specimens obtained at Roscoff. Schulze, whose specimens were taken in the Mediterranean, found that the development of the young within the parent sponge did not proceed further than the formation of the blastula, or at most of an incipient gastrula; whereas in those observed by Sollas the embryo became much developed within the parent, and the blastula stage was slurred over, apparently to economize space. No segmentation cavity was observed, but directly a cavity was necessary, the loosely aggregated cells of the morula packed themselves closely together to form the wall of the unfinished blastula, leaving their overplus in the interior in irregular heaps which subsequently arranged themselves into a unicellular layer along the line of the infolding wall of the gastrula. Professor Sollas attributes the

difference in development between the Mediterranean and Roscoff specimens to the difference of conditions, the former sea being without heavy tides and powerful currents, so that the larvæ can safely issue into the water at an early stage.——Dr. Sendenfeld claims, in *Zool. Anzeiger*, Jan. 26, to have discovered a scattered system of mesodermal nerve-cells in several kinds of sponges.

Mollusks.—After a study of the morphology of Rhabdopleura from specimens obtained at Lervik, near Bergen, Norway, Professor E. R. Lankester does not decide whether the form is polyzoan or molluscan, but inclines to the view that both it and Cephalodiscus are degraded lamellibranchs. The colony consists of branching tubes, built of a series of rings, each of which is separately secreted and added to its predecessors by the so-called buccal shield or pre-oral lobe of the polypide. A completed branch ends in an upstanding polyp-tube, while in a growing branch the axis runs beyond the last erect polyp-tube. The axial tube is divided by septa into segments, one corresponding to each polyp. When a bud reaches a certain stage of development it breaks through the wall of its chamber and grows outwards at a sharp angle. Occasionally it atrophies, leaving a sterile chamber. The buccal shield or disk is locomotive as well as secretive, and is covered with fine cilia, which occur also on the lophophoral filaments of the arms right and left of it. In the center of the ringed caulotheca or tube is the axial stalk which connects and bears the polyps. This is soft in the polypides, hard on the stem, but every hard portion is formed by the shrinkage of the soft stalk and the development of a cuticle. An internal skeleton exists in the lophophore and in the axis. The embryology of this curious form is as yet unknown, nor is it known whether the sexes are distinct or the colony persistent from year to year. ——More Pleurotomidæ. Mr. E. A. Smith describes (*Ann. and Mag. Nat. Hist.*, Nov., 1884) thirty additional species of this group.——In the same magazine (Oct.) Dr. R. Bergh has a paper upon the affinities of Onchidia. After an examination of the structure of various organs, the writer arrives at the conclusion that "the Onchidia agree with the Pulmonata in the structure of the nervous system, in the existence of a lung and of a parenchymatous kidney, in the presence of a peculiar pedal gland, and in various peculiarities of the generative system. They branch off from the Pulmonata; they are Pulmonata which have adapted themselves to an amphibiotic or marine mode of life."

Crustaceans.—Among new forms of Crustacea dredged by the *Albatross* in 1883, are an ally of Ethusa, taken in 1496 to 1735 fathoms, a species of Galacantha M. Edwds., in 1479 fathoms, two forms of Pentacheles, between 843 and 1917 fathoms, Notostomus, a Palæmonid, six inches long and of an intense dark crimson, in

1342 fathoms; three species of a new genus allied to Pasiphæ and also to Hymenodora; a Penæid of the genus Aristæas, a foot in length, and a large Sergestes, three inches long. The size of these new shrimps is remarkable, but is greatly exceeded by that of some of the deep-sea crabs. Thus the great spiny *Lithodes agassizii* has a carapace seven inches in length and six in width, and measures above three feet over the outstretched legs.

Arachnidans.—The development of Chelifer differs from that of other arachnids in the existence of a larval state as yet little known, and the structure of which has been found by M. J. Barrois to be more complicated than was stated by Metschnikoff. The number of pairs of feet is five. The nutritive vitellus is surrounded by a layer of exodermal cells preceded by an ample organ of suction opening on the ventral aspect between the two large claws (second pair). The whole forms a digestive apparatus destined to pass nutritive material into the interior of the larva. The larva is fixed upon the ventral face of its mother, and subsists parasitically upon her. The sucking apparatus is destined to fall, and its mode of elimination is singular. In the earlier stage the ventral nervous band consists of two parts, one in front of, the other behind the sucking organ. Afterwards, when the two bands are united into a continuous cord, the sucking organ is thrust outwards, becomes attached only by a thin cord below the definitive mouth, and falls at the same time with the larval envelope.

Fishes.—Karl Mobries, in a letter to *Nature*, maintains that flying fish are incapable of flight "for the simple reason that the muscles of their pectoral fins are not large enough to bear the weight of their body aloft in the air." The pectoral muscles of birds weigh on an average $\frac{1}{6}$ of the total weight of the body, those of bats $\frac{1}{13}$, those of the flying fish only $\frac{1}{32}$. The impulse is given while still in the water by the powerful masses of muscle along the sides of the body, masses which are larger than in any other fishes of similar size. The flickering motion which has been noticed is only a vibration of the elastic membrane of the pectorals, which occurs whenever the fins are in a horizontal position parallel to the wind.

Birds.—M. de Quatrefages (Ann. and Mag. Aug., Sept. 1884), ably maintains against Dr. Haast, the belief that the final extinction of the various species of moa formerly inhabiting New Zealand is due to the Maoris, and not to the preceding Melanesian natives. The discovery of bones to which the muscles and integments still adhere, furnishes a proof of this, as do the traditions of the natives. The last moa hunt of which memory is preserved, according to Mr. White, took place near Whakatone, in the Bay of Plenty. The feathers of birds killed there were until recently in the hands of a chief named Appanui.

EMBRYOLOGY.[1]

ON THE POSITION OF THE YOLK-BLASTOPORE AS DETERMINED BY THE SIZE OF THE VITELLUS.—This principle, which I have to some extent elaborated elsewhere (Cont. Embryog. Oss. Fishes, p. 114), in so far as it applies to the ova of bony fishes of different species, differing greatly in the dimensions of the vitellus, may be expanded so as to throw some additional light upon the growth and closure of the blastoderm of other groups of Vertebrata. In the paper cited I have shown that the position of the point of closure of the blastoderm in relation to the original position of the germinal disk in Teleostei is to a large extent determined by the size of the vitellus, and consequently also stands in an intimate relation to the variation of the area of the vitelline surface over which the blastodermic membrane must grow, that is to say, with the increase of the superficial area of the vitelline globe upon which the germinal disk is superimposed, and over which it spreads as the blastoderm, the position of the yolk blastopore must vary.

A yolk blastopore is met with only in such forms of ova in which there is a distinct, unsegmented or partially segmented vitellus developed. As a rule, it does not coincide with the position of either mouth or anus, but when such a coincidence does occur the yolk blastopore answers nearly or quite to the permanent anus of the Vertebrate embryo. In the Vertebrates the yolk blastopore is apt in most cases to close behind the position of the permanent anus; in large-yolked cephalopod ova it closes at the anterior or perhaps more properly on the ventral face of the yolk-sack, and seems to have no relation to either mouth or anus. This is also the case with the yolk blastopore of the embryo of Sauropsida in which it closes far behind the point where the true blastopore is formed.

In a large Teleostean ovum, as in those of the larger Salmonoids and marine catfishes, the embryo ceases to grow in length when it has extended itself over an arc of the yolk globe of, say, 90° to 125°; in Alosa, an intermediate form, it extends its growth through an arc of 180° on the surface of the vitellus; in a third and still smaller type of ovum, that of Carassius, it may apparently grow to a greater length, and embrace an arc of 230° on the surface of the yolk sphere. In the first type that part of the rim of the blastoderm not yet incorporated into the body of the embryo and lying behind the latter may be drawn out into an oval, the anterior end of this oval area, over which the vitellus still remains uncovered, lying next the caudal extremity of the embryonic axis so far differentiated, as in Tylosurus and Elacate. This usually happens when the embryonic axis does not extend over a semicircumference of the vitellus, and when that half of

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

the blastoderm opposite the embryo must grow in width more rapidly than the embryonic half in which the embryonic shield is formed.

These different modes of the growth in length of the bodies of embryos of different species of osseous fishes may easily be verified by the observation of the progressive growth of the blastoderm of the living ova, and go far towards reconciling the differences of opinion which have been expressed by different observers as to the growth of the blastoderm over the yolk. It is at any rate evident that the manner in which this is accomplished in one form does not necessarily hold true of another.

It is very significant that two large-yolked types, viz.: the Sauropsida and Elasmobranchii should both have the embryo displaced in position in reference to the margin of the blastoderm. In the latter, the first traces of the embryo have the normal marginal position at the periphery of the blastoderm, but it is soon folded off, and before the yolk blastopore has closed, the latter finally closing a little way behind the stalk connecting the embryo and yolk sack. In the Sauropsida as held by Balfour, the primitive streak apparently represents the linear thickening between the lower vitelline stalk and the point where the blastoderm finally closed in the Elasmobranchii.

It is thus made evident that, whereas the embryonic axis in Teleostei, Chondrostei, Ganoidei, Petromyzon and Amphibia extends back to the point where the yolk blastopore closes, in Sauropsida and Elasmobranchii, the embryo is partially folded off, and the tail begins to bud out before the vitellus is included by the blastoderm, and while the end of the axis of the embryo is still remote from the opening of the yolk blastopore. This contrast between the two types, as will be evident to the thoughtful person, must be due to the great difference between the bulk of the yolks in the two cases. In the large-yolked forms if the embryonic axis were to continue to grow in length and extend quite to the point where the yolk blastopore closes, the body of the embryo would necessarily develop more somites than are present in the adult, so that growth in length of the embryonic axis ceases in the large-yolked forms far short of the point of closure of the blastoderm, covering perhaps only 30° of arc or less of the entire circumference of the vitelline globe. Such a small segment of the circumference of the vitelline sphere when contrasted with 90°–125°, and on up to 180° to 230°, embraced by the primary embryonic axis in Anamniate forms, seems inconsiderable, but is really relatively as extensive as in the latter.

The germinal disk of Sauropsida is relatively much larger than that of Teleostei, so that proportionally it probably does not spread over a much larger vitelline surface in the first case than in the last in order to include the vitellus, but as the blastoderm spreads in either case, it must be obvious to any one conversant

with the mode in which the embryonic axis is formed during vertebrate development, that in the former growth in length of the axis would necessarily be completed before the blastoderm could spread over and include the yolk. Those forms of vertebrate embryos in which either the true or the yolk blastopore marks the end of the embryonic axis before the appearance of the tail bud might be called *teleporous*, while those in which there is no such coincidence, the yolk blastopore closing some distance behind or remotely away from the end of the embryonic axis, might be called, *ateleporous*. The first would include Amphibia, Petromyzon, Ganoidei, Chondrostei and Teleostei, the last, Elasmobranchs and Sauropsida. The ova of the two extremes of the vertebrate series Branchiostoma and Mammalia are yolkless, except those of Monotremata, which are probably ateleporous, simulating the Sauropsida in the general features of the development of the blastoderm and early phases of the embryo.

The band of tissue from the vitelline end of the umbilical stalk to the edge of the blastodermic rim in Elasmobranchii, and the primitive streak in Sauropsida and Mammalia are probably homologous structures. In the first instance it is formed by the concrescence of the margin of the blastoderm as it advances over the surface of the vitellus. In the Teleostei, Ganoidei[1] and Chondrostei it would seem that the whole of the margin of the blastoderm was used up by a process of concrescence to form the embryonic axis, whereas in the Elasmobranchii and Sauropsida there is a portion of the rim of the blastoderm remaining behind the embryo, which is not utilized in this way, but remains as the linear thickening of the former or as the primitive streak of the latter. While concrescence is not possible in the course of the development of the Sauropsida in the way in which it occurs in Ichthyopsida, it is known that the primitive streak is related posteriorly on either side to the *rand-wulst* or marginal thickening of the chick's blastoderm, a structure obviously homologous with the lower layer of the thickened margin of the blastoderm of the

[1] I regard the development of the germinal disk, embryonic axis and blastoderm of this type as being in no essential respect different from that of the Teleosts. The statements of Balfour and Parker, to the effect that the vitellus undergoes partial segmentation will probably be found to rest upon observations based upon material in which cracks were produced in the vitellus by reagents before the material reached their hands. The later stages show that I am right in this, the vitellus maintaining a relation to the body and intestine of the embryo quite like that observed in osseous fishes and totally unlike that noticed in the meroblastic ovum of Amphibians or Myzonts.

I am also unable to reconcile the figures given by Salensky and Professor W. K. Parker, of the fore part of the yolk-sack of the embryos of Acipenser. If the figures of the latter are correct, which they probably are, the intestine does not enclose the vitellus as represented by Salensky, but passes as a closed tube over the top of the yolk just as in Teleostean embryos, the development of the sturgeons in this respect, it will be seen, differs but slightly from that of bony fishes, a conclusion which is also supported by the way in which the yolk disappears as well as by its position in relation to the body of the embryo.

fish embryo. It is therefore interesting to note that an actual concrescence from behind forward of this rand-wulst or lower layer or a proliferation of cells from behind forwards would not be impossible. The *inner mass* of cells of the Mammalian ovum while in the vesicular or blastodermic stage is evidently in part homologous with some part of the thickened rim of the blastoderm of lower forms.

It is also a matter of great interest in this connection to observe that in the Sauropsida the rand-wulst or germinal wall is not carried along with the extreme edge of the epiblastic stratum quite to the border of the blastoderm all round as in Ichthyopsida. The epiblastic layer of the blastoderm in the Sauropsida rapidly extends beyond the lower layer or germinal wall, leaving it more or less remote from the outer margin of the germinal area. This peculiarity of development alone would be sufficient to cause the embryo to be formed away from the margin of the blastoderm in the Sauropsida, but even this I venture to suggest is to be explained by the increase in the size of the yolk of the ova of Sauropsida, the connecting link between the latter, and the teleporous Teleostean ovum being supplied by that of the Elasmobranchs, which probably represents at least one of the steps by which the evolution of the blastoderm of Sauropsida and Mammalia was attained, although it would obviously be incorrect to assume that these stages of blastodermic evolution were indicative of a serial or successional affiliation through descent. It would probably be much more rational to regard the development of these differences as being in the main due to an increase in the volume of the yolk as urged by Balfour, and that the causes of variations in its development were therefore to some extent mechanical in character.

The yolkless vesicular blastoderm of the higher Mammalia, or Eutheria, is obviously, as was supposed by Balfour, one which is to be regarded as having been derived from that of the Sauropsida. But no yolk blastopore is ever formed in the mammalian blastodermic vesicle, unless the blastopore of Van Beneden can be regarded as such. The blastopore of Van Beneden is obviously not the true blastopore, and if it can be regarded as representing the yolk blastopore, which seems very probable, the *inner mass* of cells finally involuted on its closure or covered over by the epibolic growth of the epiblast, and from which mass the mesoblast and hypoblast are derived, that mass becomes homologous with the marginal lower layer or *rand-wulst* of such a type as the Teleostean ovum.

The degeneracy of the vitellus of the ovum of Mammalia may possibly be due to the development of the so-called *uterine milk* from the uterine glands by which the egg is nourished from without during a very early stage and before the development of the area vasculosa or the vessels of the allantois is accomplished.

Intracellular digestion and growth is probably accomplished by some of the cells of the epiblast of the blastodermic vesicle, which send out pseudopodal processes between the cells of the uterine epithelium, as described by Caldwell in the case of the blastoderm constituting the yolk bag of the embryos of certain Marsupialia. Viviparity has not affected the development of the vitellus in the Teleosts, Gambusia, Zoarces and Embiotocidæ, where fœtal development is either intrafollicular or intraovarian. An albuminoid secretion is said by Blake to be found in the temporarily closed gravid ovaries of Embiotocoid fishes (*Journ. Anat. and Physiol.*, 11, 280), and in this family as well as in some of the viviparous Elasmobranchs, it seems certain that the young developing viviparously are larger than can be accounted for by the size of the vitellus of the recently fertilized egg of the same species.

It therefore seems conceivable that the Mammalian vitellus, like the ambulatory, prehensile and other organs of parasitic organisms, may have been atrophied in consequence of the perfectly parasitic connection subsisting temporarily between the maternal organism and the embryo, as was supposed by Balfour. —*John A. Ryder.*

Development of the spines of the anterior dorsal of Gasterosteus and Lophius.—The important memoir of A. Agassiz before cited, shows that the spines of the anterior dorsal of the angler and stickle-back develop in distinct diverticula of the epiblast, a diverticulum being formed for each spine into which skeletogenous mesoblast is proliferated from its lower or proximal open end. These diverticula soon become free from the anterior end of the median dorsal fin-fold, the latter, in fact, seems to degenerate or be replaced by these diverticula, the first epiblastic diverticula to be developed are more or less translocated forwards from their original positions, so that in this way these dorsal spines are finally brought to rest on the roof of the skull of the adult, considerably in advance of the point where their development began on the nape of the embryo.

The formation of the singular dorsal appendage of the larva of Fierasfer according to Emery[1] is developed in a similar way as a dorsal epiblastic diverticulum, arising from the anterior end of the median dorsal fin-fold. The singular foliar appendages along its sides grow out secondarily. This transitory organ in Fierasfer is, however, much more precociously and rapidly developed than the bony, anterior dorsal spines of Lophius and Gasterosteus; its supporting axis is evidently mesoblastic in origin as in the latter, but degenerates just about the time of the final metamorphosis of the animal into the adult condition.—*John A. Ryder.*

[1] Fierasfer. Studi intorno alla sistematica, l'anatomia e la biologia delle specie Mediteranee di questo genere. Reale Accad. dei Lincei. Ser. 3ª, Mem. Cl. di Sci., VII, 1880.

PHYSIOLOGY.[1]

FUNCTION OF THE THYROID BODY.—The experiments of Zesas (which appear in *Arch. f. Klin. Chirurg.*, Bd., LXXV) upon the effect of the removal of the spleen and thyroid body, have given interesting disclosures concerning the function of these organs. During the experiments, extirpation of the spleen was alone well tolerated, but removal of the thyroid body was followed by striking manifestations. The animals for two weeks refused nearly all food, were drowsy, walked with tottering gait, and died usually in convulsions. These effects were also manifested in animals which had survived the removal of the spleen, and from which subsequently the thyroid body was removed. In them was also observed an enormous increase in the number of white blood corpuscles. In those animals from which the thyroid body alone was removed, the increase of the white blood corpuscles was not so remarkable as it was in those in which the spleen only had been extirpated. Ablation of the thyroid body produced notable anæmia of the brain and hypertrophy of the spleen.

The lymphatic glands, especially those of the mesentery, were frequently greatly enlarged and filled with black pigment. It, therefore, appears from these experiments that the thyroid body not only has the function of acting vicariously for the spleen, but also plays an important part in regulating the supply of blood to the brain, and may, in fact, be considered as a special organ for this purpose. Zesas decides from his experiments that the removal of the thyroid body is not justifiable (surgically), and his conclusions are strongly supported by the results of this operation performed by Kocher on man for the scrofulous degeneration of the organ.—*Med. News, Jan., 1885.*

THE PLACE OF FORMATION OF UREA IN THE BODY.—MM. Grehant and Quinquaud have recently carried out on dogs a long series of experiments for the purpose of determining what are the urea-forming organs of the body. The difficulty of such work lies of course in the quantitative estimation of urea in so complex a fluid as blood. Poiseulle and Gobley concluded from their own experiments that the blood coming from an organ contained sometimes more sometimes less urea than that entering it. The method of the first named authors, though open to criticism, seems to have been followed by them with great confidence, and considerable uniformity of result. It was briefly as follows: blood was drawn directly from various parts of the venous and arterial systems, and after defibrination was thrown into several times its own volume of strong alcohol. The residue left after evaporating the alcoholic extract to dryness was treated with water; a known quantity of this solution was received in a vacuum and its urea decomposed by a solution of mercury in an excess of

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Mich.

nitric acid. Urea is thus decomposed into equal volumes of carbonic acid and nitrogen which were easily estimated.

It appeared from these experiments that the blood of the hepatic veins, splenic veins and the portal vein contains always more urea than the blood of the carotid artery, whence it is concluded that the abdominal viscera are the seat of continuous urea formation.

There was no notable difference in urea content between the blood coming from the head or the different members and that blood which entered those parts.

The chyle mixed with lymph drawn from the thoracic duct after death was always found richer in urea than either venous or arterial blood.

The difference between the urea content of venous and arterial blood was much more marked in animals during the digesting than in the fasting condition. This agrees with the statement of Becker & Voit, who found the excretion of urea much increased during digestion.

It may be said that these observations are difficult to reconcile with the well founded belief that the liver is the principal organ for the formation of urea in the body.—*Journ. de l'Anat. et Phys., 1884, p. 317.*

On the Specific Energy of the Nerves of the Skin.—The underlying facts of Joh. Müller's generalization that the nerves of special sense, as the optic, auditory, gustatory, filaments are endowed with specific energies cannot be disputed. What is meant is that any kind of stimulus whatsoever applied to the optic nerve arouses the sensation of light, every irritation of the auditory nerve gives rise to the sensation of sound, &c. The characteristic quality of these sensations depends not at all upon the peculiarity of the sensory nerve, but is determined wholly by the physiological properties of the nerve cells which receive the sensory impulse.

From the skin, as a sense organ, we receive impressions that arouse in us at least two different kinds of sensations, those of pressure and of temperature, and it is an important question whether the impulses giving rise to these different sensations proceed along identical nerves which reply in a different manner to differences in the quality of the stimulus, or whether the nerves of the skin are functionally differentiated in such a way as to call forth specific sensations without regard to the character of the stimulus. Weber believed that sensations of temperature and of pressure were modifications of the same sense, depending upon the amount of energy aroused in the sensory nerve. Physiological analogy throws doubt upon this interpretation, and recently Blix has produced evidence which supports the view that the various sensations aroused by excitement of the skin are as truly specific and due to the excitement of distinct nerves, as is the case with the other special senses. Blix used as stimulus the faradic elec-

trical current. One electrode was fixed to the skin by a broad moistened contact, while the other electrode, used in exploring the surface, ended in a fine metal point. By graduating the strength of the current, sensory irritation was confined to the region of the pointed electrode. It was found that electrical stimulation of different areas of the skin produced different sensations. At one spot the irritation excited only pain, at another a sense of cold, at a third of warmth, at a fourth, it might be, of pressure. Hence, it may be concluded, that the quality of the sensation depends not on the nature of the stimulus but upon the specific energy of the irritated nervous apparatus.

The author thinks he has shown that sensations of cold and warmth, respectively, are excited through different sets of nerves. The *cold* nerves are broadly scattered over the skin and their endings are rather deeply buried in its substance. The *warm* nerves are distributed to well-defined small areas from which alone we attain sensations of heat. A cold piece of metal, a square centimeter in section, laid upon a certain part of the forearm, produces no sensation of cold, while a pointed instrument of the same metal, at the same temperature, with a contact surface of only half a square millimeter, gives intensely cold sensations when applied to certain parts of the skin in the immediate neighborhood of the insensitive area.—*Zeitsch. f. Biologie, Bd. xx, p. 141.*

PSYCHOLOGY.

INTELLIGENCE OF A SETTER DOG *(Continued).*—It is perhaps proper for me to here refer to the peculiar fancy of the bitch Frank. Barney was always her choice and strange as it may seem —with him there was no reciprocation.

I have tested her pretty thoroughly, and I can say that she has not thus far permitted a dog not her own color to line her. And as a further proof a short time ago, being a few days before her season of heat, she left the farm seven miles distant upon which I had her kept and returned here.

There are numbers of dogs in the neighborhood where she was kept, but she returned and when a dog of different color from her own was offered she would fight desperately. Although kept on the farm for several months this was the only time she had left it.

Experimenting as I have with a number of dogs and bitches, I have noticed that some are very choice in their selection of a mate, while others are not. Some bitches will permit several to line them, even without interval, while others will not have but one serve them. Barney would not serve a wolf, *Canis latræs*, but Wad did. As a further evidence for comparison, showing the difference between the likes and dislikes of dogs, I give the following: Frank, as above stated, chooses a mate only of her own color, while Barney's greatest aim is to frolic with and if possible to line a pointer bitch in color nearly white, with a few black spots.

A dog more mischievous or one more noted for his original pranks, I never owned. Many of the little things usually taught a dog were not to his liking, and for this reason would at times bring harsh words upon him, but for originality I have not known his equal.

He had been taught to carry quite heavy loads of shells for me into the field to use in hunting, and in this manner he was much strengthened in his jaws. It was an easy task for him to pick up a twenty-five pound sack of shot and carry it a hundred or more feet. One time he surprised me in this feat, for I had used a sack of shot to tie him to in the office. Frank was also tied to another sack near by. I picked up the sack of shot she was fastened to and led her to another part of the office, to another room. After a few moments Barney came in carrying his sack of shot. I had not intended moving him but this ingenuity was too much in the dog's favor, he was permitted to remain.

While hunting it was a common practice for him to stand in front of me when shooting from a point, stand or blind, and while I could watch all birds that came towards me, he would give me signal by the expression of his eyes and movement of his head from which way I could expect the best shot, and many times I have waited until from his signs it was evident the birds were in close range, then turning around rapidly make a good shot.

In hunting small birds he was exceptionally fine, for when out with me collecting specimens, as I would crawl along closely watching the habits perhaps of some minute bird, he too would walk as stealthily as a cat and many times he has by his cautious actions, a look up into the tree or a wag of his tail, called my attention to one or more birds I had not as yet noticed in the tree under which we were observing.

Before going to Labrador he was a fine retriever—retrieving even a kinglet or the smallest warbler in the most careful manner, but his battles with the many wounded puffins *(F. arctica)*, he retrieved while in Labrador, changed him so that it was unsafe to permit him to retrieve a small bird thereafter.

His facial expression was excellent and at no time more interesting than when astonished. At about six months of age I began working him to retrieve small birds in the field, this he did quite nicely upon ground where it was easy for him to find them, but one time the bird fell into one of the deep ravines so common along our western water-courses. Nothing daunted he jumped over the bank and was soon sliding or rolling or running down the side to the bottom; he found the bird and started for the top and was nearing the edge of the level ground when the earth slid out from under him. I was near enough to witness the whole and saw him open his mouth and swallow the bird, and then at once upon getting over his fright, in the greatest astonishment, look around, then at me as much as to enquire where was the bird?

He had no appreciation of the fact that that very small bird could have been swallowed, but as I saw him do it, there was no doubt on my part. For some minutes he labored to find that bird, even going to the bottom of the ravine, and I to change his thought shot another bird which fell into the ravine and was retrieved by him.

Another time when his facial expression was very fine, was at a time when he caught a wounded duck that had fallen near me, and while he had her in his mouth I shot another duck, and this second one also falling very near me and the dog Barney opened his mouth and the bird he had in it flew away. Without taking his eyes off the fleeing duck he watched until she had lighted upon some high land away from the water. The next day I put him to work upon the high land to find the duck, and never did I see him more pleased than when he brought the duck yet alive to me.

To give a statement of all the various strange proceedings of this dog would take too much space, for they are many, but to close I will give what perhaps was his last attempt to outwit me and to gratify his own high intelligence.

While collecting birds and animals in Dakota in the fall of 1883, near the close of the season I shot a muskrat in one of the lakes. Barney went out to where it was, in shallow water upon a sand bar, rolled it over with his foot and came towards me without it. Speaking harshly to him he returned picked up the rat and brought it to me on shore. Going towards camp I signaled him to bring the rat with him; after a few moment she complied, and as he trotted along by my side for some distance in apparently high glee I thought no more about him until I got to camp, then looking around for him I could not find him. After a little while he returned to camp and coming up to me licked my hand. Signaling to him to "bring" he instantly went away and laid down under a wagon. Believing then that he had dropped the rat I took a whip and until I gave him a very severe whipping he would not heed my demand. After he had received sufficient to conquer him he trotted off in the direction we came, and as I watched him saw him go to a bunch of undergrowth a couple of rods from the path I had come in on and there began digging where he had buried it. In a few moments he came trotting to me with the rat in his mouth. I then went to camp and he followed, carrying the rat.

The next morning at the door of my tent I accidentally shot this my best of companions, the dog who had been my assistant and watcher over many thousands of miles, by one of those most dangerous, yet very handy guns, the hammerless.—*D. H. Talbot.*

An affectionate Angora Cat.—A. Espagne gives to the *Revue Scientifique* a story of a half-breed Angora cat of exceeding docility and affection. During about fifteen days of every

year this cat left the house, ignored the calls of its owners, and led a wild life around the neighborhood. At the end of this time it returned, and was demonstratively affectionate. It was particularly attached to the aged head of the household, was always at his side or on his knee during the day, and at night slept at his feet. When he died, the cat mewed in a sad monotone never before heard from her. Four years afterwards a baby, to which the cat had transferred her affection, was taken sick and died. During its illness the cat remained most of the time below the cradle, ate little, and lost the brilliancy of its eyes. On the return of the family from the country the cat lay dying in its accustomed place, and was found dead in the morning. Though age and the cold wave which took the infant's life may have had their share in the matter, it yet seems that sorrow was the immediate cause.

C. Jamelin gives a story of a charitable Angora cat of magnificent presence, but not usually very intelligent. This cat many times brought home a hungry cat as if to obtain food for it, and finally maintained a regular pensioner. The first time the estray was brought, the Angora mewed and jumped around till food was given to it, watched it while eating, and then accompanied it to the door, hastening its departure with a series of light quick pats. The strange cat learned the lesson, and often came again as a visitor but not to stay.

Intelligence of Tortoises.—Anecdotes in the *Revue Scientifique* appear to show that these creatures must be credited with a considerable amount of intelligence. M. Boucard writes of one which lives in his garden, and, when called aloud by its name, Laideron, would immediately run towards the voice with all the speed a tortoise can muster.

The *Testudo mauritanica* of M. Boisse showed even more intelligence, learned to come when called by a hissing sound, followed its master like a little dog; relished caresses bestowed on its head and neck, gave gentle bites to show its affection, and would climb upon its master's boots or pull at his clothes to draw his attention.

ANTHROPOLOGY.[1]

Eastern Sudan.—Professor A. H. Keane favors us with a most valuable piece of ethnological work on the tribes of Eastern Sudan, at a time when all eyes are turned in that direction (J. Anthrop. Inst., xiv, 91–110). Although the scheme is somewhat lengthy we present it in full, omitting the descriptive portion:

I. Bantu Group.

Waganda. N. W. of Victoria Nyanza, from Somerset to Alexandria Nile.
Wa-Nyoro. Between Somerset Nile and Albert Nyanza.
Wa-Soga. East from the Somerset Nile.

[1] Edited by Prof. Otis T. Mason, National Museum, Washington, D. C.

Wa-Gamba. East of the Wa-Soga.
Wa-Karaqwé. W. of Victoria Nyanza, from Alexandria Nile S.
Wa-Songora. W. of Victoria Nyanza, between Wa-Karaqwé and coast.

II. Negro Group.

Kavirondo, *Kuri*, *Kara* } E. of Victoria Nyanza, from the Wa-Soga to Kerewé Is. Speech Negro and akin to Shilluk.

Nauda. Nauda uplands, north of Kavirondo.
Masai. Kilimanjaro and west towards V. Nyanza.
Kwafi. W. of Mt. Kenia, N. of Masai.
Shefalu. N. of U-Nyoro, akin to Shilluks.

Madi, *Shulé*, *Laboré* } Between Lower Somerset Nile and Madi mountains, limited westward by the Bahr-el-Jebel.

Janghey, *Fallanj*, *Niuak* } Lower Sabat basin.

Bari. Both sides Bahr-el-Jebel, 4°–5° N., limited N. by Shir territory.
Monbuttu. Headwaters Welle r., beyond Egyptian frontier.
Zandeh. S. W. frontier Egyptian Sudan w. The *Niam-Niam* of Nile tribes.
Mittu (Mattu). A-Madi, Madi-Kaya, Abbakah, Luba, N. of Monbuttu.
Bongo (Dor). Upper course of Tondy and Jur rivers to Zandeh.
Shir. Bahr-el-Jebel, 5°–6° N., between Dinkas and Baris.

Rol, *Agar*, *Sofi*, *Lehsi* } Tribes of uncertain affinity along Rol r., east of Bonqus and Mittus.

Nuer (Byor, Ror). Along lower course of Bahr-el-Jebel, 7°–9° N.
Dinka (Abuyo, Agar, Ajak, Aliab, Arol, Atwot, Awan, Bor, Donjol, Jur, Gak, Rish). Along Bahr-el-Jebel and right bank of White Nile, 6°–12° N.
Shilluk (Kwati, Dyakin, Dyok, Roah). Left bank of Bahr-el-Jebel and White Nile, 9°–12° N.

Dwuïr, *Ayarr*, *Mok*, *Tondy*, *Bót*, *Ayell* } Unclassed tribes south of the Dinkas, N. E. of Bongos, 7°–8° N.

Takruri. Gallibat district, Abyssinian frontier (James's "Wild tribes," 30).
Funj. Dominant in Senaar, probably Shilluk, mixed with Arab.
Krej. Headwaters of Bahr-el-Arab, beyond Egyptian frontier.

III. Nuba Group.

Nubas proper. *Nuba*, *Kargo*, *Kulfan*, *Kolaji*, *Tumali.* Kordofan, chiefly cent. and south, 11°–13° N.

Western Nubas
- *Fur.* Dominant in Dar-Fur.
- *Kunjara.* Branch of Fur. Darfur and Kordofan.

Nill Nubas ("Nubians," "Barabra")
- *Mattokki* (*Kenus*). Asuan to Sebi and Wadi-el-Arab.
- *Suidokki* (*Mahai* or *Marisi*). Korosko to Second cataract.
- *Dongolawi.* Dongola, Wadi-Halfa to Jebel Deja near Meroe.
- *Danagele.* Nubian immigrants into Kordofan and Dar-Fur.

IV. SEMITIC GROUP.

(*a*) HIMYARITIC OR ABYSSINIAN BRANCH.

Dahalaki. Great Dahalak Is. near Massawa.
Massuai. Mixed people of Massawa, Tigré speech.
Hotumlu, Karneshim, Az-Shuma, Dokono. Mudun (Samhar) coast, about Massawa as far as Aqiq.
Habab, Bejuk, Mensa, Bogos, Takue, Marea. Auseba province, N.E. frontier of Abyssinia inland from Mudun.
Algeden, Sabâerat, Dembela. Beit-Bibel and Dembela districts, head streams of the Barka and Mareb, W. of Anseba.
Harrar. Abyssinian enclave in Somaliland, E. from Shoa.
Tigré. Predominant nation in North Abyssinia.
Amhara. Predominant in So. Abyssinia, subject to Tigré.

ISMAELITIC OR ARAB BRANCH.

Shukrieh, Dobeina, Yemunieh. Lower and Middle Atbara, S. to Senaar.
Jalin (*Jahalin*). Blue Nile confluence, Khartum, and Senaar, Taka, Kordofan, Dar-Fur and Kaffa.
Kababish. W. of Nile, 12°–15° N. and between Obeid to the Nile at Dongola.
Baqqara. S. of Kababish, W. of Nile and Bahr-el-Arab.

V. HAMITIC GROUP.

TIBU BRANCH. *Baele, Ennedi, Zoghâwa.* N. of Dar-Fur; N. W. to Wanganya and Borku; Speech like Dasa or So. Tibu; type Negroid.

BERBER BRANCH. *Fulah.* W. of Dar-Fur.

SO. ETHIOPIAN BRANCH.

OROMO OR GALLA

Ittu. Ittu Mts., 41°–42° E., 9°–10° N.
Carayu. S. E. of Ankober.
Dawari. W. from Tajurra bay.
Wolo. W. of Lake Ardibbo.
Wooro-Babbo. E. of Lakes Ardibbo and Haic.
Mecha. S. of Gojam.
Raya, Asabo. W. of Zebul.
Lango. Somerset Nile, Fowura, to Magungo.
Wa-Huma, Wa-Tusi. With Bantus, E. Equatorial regions.
Sidama. Kaffaland, S. W. of Shoa. Wrongly Nubas.

SOMALI

Isa, Isa-Ishaai-Modaba, Gudabirsi, Habr-Awal. Between Zeilah, Harrar and Berbera.
Habr-Gerhajis. Uplands S. of Berbera.
Godahursi, Dalbahantu, Warsingali, Mijjerthain. E. of Berbera to Indian ocean.

CENTRAL ETHIOPIAN BRANCH

AFAR OR DANAKIL

Debnet, Asoba, Assa-Imara, Sidi-Habura, Galeila. Coast between Abyssinia and Red sea, from Zula bay to Strait of Bab-el-Mandeb.

Khamir (Lasta district), *Aqau* (Quara district), *Agaumeder* and *Khamant* (Gondar district) of Abyssinia.
Saho or *Shoho.* N. E. frontier Abyssinia.

THE RETRIEVING HARPOON; AN UNDESCRIBED TYPE OF ESKIMO WEAPON.—There was found in universal use at Point Barrow, Arctic Alaska, a peculiar form of harpoon, exclusively used, as the name I have suggested for it implies, for retrieving seals that

have been shot in open holes or "leads" of water, within darting distance from the edge of the ice. The Eskimos call it "*naú-lĭ-gû.*"

It consists of a long light shaft (*i-pù-ä*) of wood, about one inch in diameter, and generally about five feet long, though the length varies with the height of the man who uses it. The butt of this is armed with a slender bayonet-shaped ice-pick (*tú-u*) of walrus ivory, about fourteen inches long, and to the other end is securely fastened a heavy pear-shaped foreshaft (*u-ku-maí-lu-ta*, "weight") of walrus ivory or compact bone, which serves to give weight to the head of the harpoon and make it fly straight. It is about five inches long and an inch and a half in diameter at the forward end. In the center of the end of the foreshaft is a deep round socket into which fits the butt of a slender rod of ivory about two inches long, the "loose-shaft" (*i-gi-mû*). This is secured to the foreshaft by a thong passing through a hole drilled in it, so that it can be easily removed from the socket, while the thong prevents it from being dropped and lost. On the tip of the loose-shaft fits a detachable toggle-head (*naú-lû*) of the ordinary type common to the whole Eskimo race, provided with a long line of seal thong upwards of ninety feet in length.

When ready for use the line is drawn taut from the head to about the middle of the shaft, made fast by a couple of half-hitches, and kept from slipping by a little ivory peg (*kí-ler-bwĭñ*) inserted into the shaft. Just back of this there is also a little curved ivory knob (*tí-ka*) secured to the shaft as a rest for the forefinger in aiming the weapon.

The hunter on starting out carries his rifle slung in a sort of holster across his back, and secured to this the *naú-lû* and line folded in long hanks. The rest of the harpoon is carried in the hand and serves as a staff in walking and climbing among the ice-hummocks, where the sharp pick is useful to prevent slipping and to try doubtful ice, and also enables the hunter to break away thin ice at the edge of a hole so as to draw his game to the solid floe. It can also serve as a bayonet for defence in case of necessity.

When a seal has been shot and floats, the *naú-lû* and line are fitted on and the weapon darted with the right hand while the left holds the end of the line. The *naú-lû* enters the animal entirely, and a pull on the line causes it to slip off the top of the loose-shaft (which is facilitated by the play of the latter) and to toggle securely under the skin. The whole is then drawn in by the line.

The use of this weapon appears to be confined to Northwestern Alaska, and it is very rarely found south of Bering's strait. In the large collection made by Mr. E. W. Nelson in the neighborhood of Norton sound, there is only one rather clumsily-made *naúligû*, with a fragment of the line, which is labeled a "beluga

spear." It is manifestly unfitted for such use, but this statement goes to show that it was an unfamiliar weapon among the people by whom he was surrounded. The natives of that region, as well as the Greenlanders and Eastern Eskimos, retrieve seals with the kaiak, occasionally using the stabbing harpoon common to the whole Eskimo race, to secure a seal, but they are unprovided with any special weapon for retrieving.

We were unable, during our stay at Point Barrow, to ascertain whether this weapon was in use before the introduction of fire-arms, which are now universally employed, but I am strongly led to conjecture that it is a modern invention.

I am of the opinion that the people of this limited area, enabled by the introduction of firearms to kill seals in the open holes of water, where they had previously been safe from the ordinary spear, and prevented from using the kaiak from the extreme roughness of the ice, invented this weapon by reducing the great walrus-harpoon to a convenient size for carrying on the ice. It is a perfect miniature of the walrus-harpoon, with the addition of the ice-pick, an essential part of the ordinary stabbing-harpoon.

I am strengthened in this opinion by the fact that Dr. Simpson, who spent the winters of 1852–3 and 1853–4 at Point Barrow, before the general introduction of firearms, makes no mention of the use of this weapon in his excellent paper on the Western Eskimos. He would undoubtedly have done so had he seen it, so different is it from the ordinary Eskimo methods of seal-hunting.—*John Murdoch.*

MICROSCOPY.[1]

La Biologie Cellulaire.—The first number of a comprehensive treatise on general cytology, bearing the above title, has just been published. Two more numbers are to follow, which will make a large octavo volume of seven or eight hundred pages, illustrated with over four hundred cuts. The price of the first number is twelve francs, while the subscription price of the complete work is twenty-five francs. It may be obtained from H. Engelcke, 24 Rue de l' Université de Gand, Belgium.

The author, J. B. Carnoy, professor of general biology in the Université Catholique of Louvain, has undertaken a comparative study of the cell in both kingdoms, and proposes to make the treatment of the subject as complete and thorough as possible in the present state of our knowledge.

Our notions of the cell have been clearing rapidly in recent years; and, although we are still far from a complete knowledge of this many-sided subject, the time seems to have arrived when cytology may properly be recognized as an independent branch of learning, as it has been for some years in the university of

[1] Edited by Dr. C. O. Whitman, Mus. Comp. Zool., Cambridge, Mass.

Louvain. The key to some of the deepest mysteries of life, is to be found, if at all, in the study of the cell; and for this and other reasons that do not call for mention, we are glad to see the subject treated as a science, and not in the narrow methods of a mere historical compendium.

The work is intended for *laboratory use.* "*It is needless to remark*," says the author, "*that no lesson in cytology can be mastered outside of the microscopical laboratory.*" Its aim is to furnish the student with a proper foundation for the study of life in any of its aspects, and both student and teacher with a guide to the most favorable objects of study, and the best instruments and methods now in use.

Thus stated, the chief aim of the work would seem to be nearly identical with that of the well-known Practical Biology; but the subject-matter and the method of dealing with it are quite unlike in the two cases. Huxley's course deals with the morphology and physiology of a few typical vegetable and animal organisms; Carnoy's course deals with the chemistry as well as the morphology and physiology of the cell, as the structural unit of all organisms. The one makes use of both macroscopical and microscopical methods of observation; the other employs almost exclusively methods of microscopical technique. The Practical Biology pursues methods of its own, and aims to impart, through laboratory work, such information as should form a part of so-called general education; the Cellular Biology limiting itself to a single subject of general and fundamental importance, proposes to deal with it in an encyclopedic fashion and thus to lay a broad and solid foundation for special study in botany, zoölogy, or physiology. The former points out the direct way to a system of facts, and deals very sparingly in interpretation; the latter adds to its facts and methods, history, discussion, and general interpretation. The English manual is an excellent guide for the general student, who merely desires some knowledge of typical organisms; but the training it offers, though admirable as far as it goes, falls short, in some important particulars, of being an adequate preparation for original investigation in either of the above-named departments of biology. The French manual, if completed with the thoroughness that characterizes the first number, will furnish, in our opinion, not only a much-needed book of reference, but also a course of study which exactly meets the needs of those who are preparing for independent work.

The general scope of the work may be seen from the following introductory remarks by its author: "A course in general cytology should embrace the study of both the animal and vegetable cell. * * * The essential characters of organization, and the fundamental biological laws, are the same for all living beings. * * * It is only after having searched the two kingdoms, after having followed the organized element step by step, and through

the entire series of living forms, that it becomes possible to gain a conception of it, which can be called exact, truly scientific and fruitful.

"Cytological instruction should be *complete* and *searching*. In order to be complete, it should survey the cell from all sides, from the standpoint of morphology, anatomy, physiology and biochemistry; for it is under these several aspects that it will serve as a basis for subsequent study. In saying that it should be searching, we should take care to demand that it be encyclopedic; a course which loses itself in details would not be thorough. What we desire is, that the student shall be made to penetrate into the inner life of the cell, and actually to lay hold of both the essential and accidental chemical constitution of living matter, the fundamental organic constitution of different parts of the cell—membrane, protoplasm, nucleus; to reflect long upon the principal physiological phenomena—indispensable foods, elaboration, digestion, assimilation, &c.; upon the general movements of the cell—cleavage, fecundation, different movements of the protoplasmic reticulum; upon differentiation, cellular geotropism and heliotropism," &c., &c.

The first part of this first number of the work containing 167 pages, is devoted to the instruments and methods of microscopical research. The first of the three books into which it is subdivided, treats of the microscope and its accessories, the microspectroscope, polarizing apparatus, the micrometer, goniometer, photographic apparatus, and camera lucida; and closes with a chapter on the laboratory, aquaria, and reagents.

The second book considers the objects or materials of study, and the methods of preparation, including the microtome and its uses.

The third book devotes one chapter to "the education of the eye," another to "the examination and treatment of preparations," and a third to "the method to be pursued in scientific researches and publications."

The second part opens with a valuable historical preliminary, and a discussion of general notions of the cell, including terminology and definitions. Then follows a book of sixty-five pages devoted to the *nucleus*—its chemical constitution, structure, and morphography. The remaining three books of this part, dealing with *protoplasm*, the *cell-membrane* and *general discussions*, will appear in the second number.

The historical summaries, and well-arranged bibliographical references, form a very valuable feature of the work; and the same may be said of the chapters devoted to methods of research, which contain much that is new. The cuts are *all* original. They are well executed, and for the most part well chosen; but this is a point in which originality might have been curtailed and well selected illustrations borrowed from different sources.

Professor Carnoy has undertaken an extremely difficult task, and the success with which he has accomplished the first part is a sufficient guaranty of an equally successful conclusion. The best that we can wish for it is, that it may meet with a reception as favorable as it deserves.

PERGENS'S PICROCARMINE.[1]—I. 1. Boil for two and a half hours 500 grms. pulverized cochineal in thirty liters of water.

2. Add fifty grms. *potassic nitrate*, and, after a moment of boiling, sixty grms. *oxalate of potash;* boil fifteen minutes.

3. After cooling, the carmine settles: it is washed several times with distilled water in the course of three or four weeks.

II. 4. Pour a mixture of one volume of ammonia with four volumes of water upon the carmine, taking care that the carmine remain in excess.

5. After two days filter, and leave the filtered solution exposed to the air until a precipitate forms.

6. Filter again, and add a concentrated solution of picric acid; agitate, and then allow it to stand twenty-four hours.

7. Filter, and add one gram chloral for one litre of the liquid.

8. At the end of eight days, separate the liquid from the slight precipitate which is formed, and it is ready for use.

This fluid keeps unchanged for at least two years, and is recommended by Carnoy above other picrocarmine solutions.

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS.[2]—The seventh volume of the Proceedings of the American Society of Microscopists contains, besides President Cox's address on Robert B. Tolles, about forty articles, some of which contain valuable information for the microscopist. We may call especial attention to the articles on Photomicrography by the President and H. F. Atwood; the observations of the editor in chief, Dr. D. S. Kellicott, on Infusoria, Rotatoria, &c.; thoughts on Sponges by Henry Mills; a new mounting medium by H. L. Smith; serial sections by S. H. Gage; hints on hardening, imbedding, cutting, &c., by Geo. Duffield; a cover-glass cleaner by T. L. James; the ideal slide by F. M. Hamlin; the magnifying power of objectives and lenses by W. H. Bulloch; a method of staining and mounting by J. T. Brownell; a lens holder by R. H. Ward; an improvement in objectives by Ernst Gundlach. The volume contains other articles of more or less interest, report of committee on standard micrometer, and on oculars.

JOURNAL OF THE NEW YORK MICROSCOPICAL SOCIETY.—The first number of this new microscopical journal contains an interesting article on Electrical Illumination in Microscopy, by E. A. Schultze; and another entitled Criticisms on Mr. J. Krutt-

[1] Biologie Cellulaire, by J. B. Carnoy, p. 92, 1884.

[2] Seventh Annual Meeting, held at Rochester, N. Y., Aug. 19–22, 1884.

schnitt's Papers and Preparations relating to Pollen-tubes, by N. L. Britton. The rest of the number is given to the Proceedings of the Society, Miscellanea, and an Index to Articles of Interest to Microscopists.

In the meeting of December 5th, J. D. Hyatt speaks of Hydrogen Peroxide as a Bleaching Agent, but gives no details of the process.

This journal is edited by Benjamin Braman, and is to be published in nine monthly numbers, from November to July, inclusive.

METHOD OF MAKING ABSOLUTE ALCOHOL.—Dr. Sharp states that absolute alcohol is prepared in Ranvier's laboratory by adding anhydrous cupric sulphate to ninety-five per cent alcohol.[1]

Pulverized cupric sulphate is heated to red heat in order to drive off the water of crystallization; when cool the white powder is placed in a wide-mouthed bottle, holding about a liter, and three-fourths full of alcohol. The bottle is quickly closed and the whole shaken. After standing a day or more—with occasional shakings—it is decanted and the operation repeated, especially if the cupric sulphate shows much of the blue color due to the reassumption of water.

As a test a drop of the alcohol thus dehydrated may be mixed with a drop of turpentine on a glass slide, and examined under the microscope; if no particles of water are to be seen the alcohol is absolute enough for all practical purposes.

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SCIENTIFIC NEWS.

—Mr. J. Dillon forwarded a paper to the Montreal meeting of the British Associations on an automatic sounder for the use of the explorer, in determining depths in rivers and lakes, and the character of the bottom. Over the side of the vessel is a long sounding bar or tube, in length 10½ feet, or more, which bar works freely round a fixed center inside the boat. This fixed center is placed in the middle of a circular dial on which are marked fathoms or feet, a duplicate dial being placed in the captain's cabin. On mooring the boat over a shoal rising to the surface, the sounding bar, which always hangs vertically, will strike the shoal from its weight. The bar will run along the ground, pointing to the number of feet on the dial, representing the depths of the shoal under the surface of the water. It has been found that the vibrations of the sounding bar differ in degree when the boat moves it along different formations, thus enabling the observer, after very short experience, to record in his note-

[1] Roscoe and Schorlemmer state that anhydrous cupric sulphate is a good test for the presence of water, but not a suitable means for preparing absolute alcohol.

book whether the surface of the ground under the water is composed of mud, sand, gravel, boulders or rock.

—The Department of Biology of the University of Pennsylvania, which promises to be one of the leading schools of the "science of life," has been formally opened. Dr. Joseph Leidy is director of the department. Its aim is to encourage original research in biology, by offering facilities to scientists engaged in investigation and by giving instruction to advanced students prosecuting special work. The university has rented a table at Dr. Dohrn's Zoölogical Station, Naples, Italy, Dr. Charles Dolley being its representative. Mr. Edward Muybridge, whose attention to the study of the motion of animals and the illustration of them by instantaneous photographs has gained him favorable mention throughout the country, will work with the faculty, in photographing, and will give instruction in this branch to those who desire it.

Further information respecting the department may be obtained from Professor H. F. Jayne, M.D., secretary of the faculty, 1826 Chestnut street, Philadelphia.

—The third volume of the memoirs of the National Academy of Sciences, which has been transmitted to Congress by its president, Professor O. C. Marsh, of New Haven, contains the proceedings of the academy for 1884, and the following papers: 1, The sufficiency of terrestrial rotation for the deflectian of streams, by G. K. Gilbert; 2, On the temperature of the surface of the moon, by Professor S. P. Langley; 3, On the determination of the laws of the vibration of tuning forks, with special reference to the action of a simple chronoscope, by Professor A. M. Mayer; 4, On the Baume hydrometers, by Professor C. F. Chandler; 5, On small differences of sensation, by Professor C. S. Peirce and J. Jastron; 5, Description of an articulate of doubtful relationship from the tertiary beds of Florissant, Colorado, by Dr. S. H. Scudder; 7, The structure of the Columella auris in the Pelycosauria, by Professor E. D. Cope; 8, On the structure of the brain of the sessile-eyed Crustacea, by Professor A. S. Packard.

—The existence of a cavern in the neighborhood of Beaver hole, on Cheat river, near St. George, W. Va., has been known for years; but it was never explored until the past week, when a party of men devoted a day to an examination of the cave. It proves to be a remarkable cavern, or rather a series of caverns, for there are five of them, one above the other. The lower one was explored a distance of a mile, and the upper one two miles. There is a small stream in the lower one, but the upper one is comparatively dry. The rooms are large and have evidently been cleared of débris at some former period. In one evidence of a fire was found, and the remnant of bones, which were brought

out and will be sent to an antiquarian for identification. The cave is almost on the line of the new West Virginia Central Railroad.

—The Amsterdam *Allgemein Handelsblad*, publishes a communication from Professor Cohn, recapitulating the substance of the correspondence between Leeuwenhoek and Francis Aston, F.R.S. The celebrated naturalist, writing from Delft in 1683, tells Aston how, with the aid of the microscope, he had discovered and distinguished minute organisms amongst the particles of food removed from between his teeth. In 1692 Leeuwenhoek sent sketches of these organisms to the Royal Society; but he experienced a period when he could not discover any traces of them, and attributed their disappearance to the use of hot coffee.—*English Mechanic.*

—The works of Darwin are not allowed to be issued from the circulating libraries of Russia, and a recent imperial decree puts those of Agassiz, Huxley, Lubbock, Adam Smith, Lewes, and Spencer on the same list. The new list is not confined to English and American authors, for Moleschott, Büchner, Vogt, Reclus, and others are considered unsuitable for Russian readers.

—The death is announced of Mr. John Gwyn Jeffreys, LL.D., F.R.S., the distinguished conchologist and naturalist. Mr. Jeffreys was born at Swansea, in 1809, and was called to the bar; but about twenty years ago he retired from practice, and devoted himself entirely to his favorite branch of science. In his early life he was an enthusiastic dredger, and as soon as he was able purchased a yacht in order the better to prosecute his work. When the *Porcupine* was fitted out in 1869, in company with Dr. Carpenter and the late Sir Wyville Thompson, Mr. Jeffreys conducted the exploring voyages, and subsequently superintended the scientific work of the *Valorous*, when that frigate accompanied our latest Arctic expedition as far as Davis straits. His first paper was contributed to the transactions of the Linnean Society at the early age of nineteen, and since then his contributions to the transactions of the Royal and other societies, have been both numerous and valuable.

—Professor Lauritz Esmark, director of the zoölogical museum of the University of Christiania, Norway, died in December last. He once spent nearly two years in this country, traveling extensively, and was hospitable to American naturalists visiting in Norway.

—Vice-Admiral H. W. Bayfield died at Charlottetown, N. S., February 12, aged 90 years. He will be remembered for his surveys of the St. Lawrence gulf and the coast of Labrador.

—The death is also announced of Dr. Friedrich von Stein, professor of zoölogy and zoötomy in the University of Prague for thirty years. Professor Stein was sixty-seven.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, Feb. 7.—Communications were made by Dr. H. G. Beyer, U. S. N., report on intracellular digestion and its relations to pathology; by Dr. J. A. Ryder, on the probable origin and homologies of the flukes of Cetaceans and Sirenians.

Feb. 21.—Communications were made by Dr. Theodore Gill, on the relative values of different types in palæontology; by Dr. H. G. Beyer, U. S. N., on genital apparatus of Lingula; by Mr. J. L. Wortman, on a method for exhibiting the relationships of the bones of the skull; by Mr. Frederick W. True, on the recent capture of right whales off Long Island.

APPALACHIAN MOUNTAIN CLUB, Feb. 13.—A lecture on Colorado, New Mexico, and Utah, illustrated by stereopticon, was given by Rev. A. E. Winship.

BOSTON SOCIETY OF NATURAL HISTORY, Feb. 4.—Mr. Wm. M. Davis read a paper on geographic evolution, illustrated by models for use in teaching.

AMERICAN GEOGRAPHICAL SOCIETY, Feb. 26.—David Dudley Field, delivered a lecture entitled, Nomenclature of cities and towns in the United States.

NEW YORK ACADEMY OF SCIENCES, Jan. 19.—The following paper was read: Glacial observations in Canada and on the Northern borders of the State of New York, by Dr. A. A. Julien; Prof. D. S. Martin exhibited some views and photographs of interesting geological scenery.

Feb. 9.—The following paper was read: Tin deposits in the Black Hills of Dakota (illustrated with specimens and photographs), by Prof. G. E. Bailey.

PHILADELPHIA ACADEMY NATURAL SCIENCES, Dec. 4.—Professor Heilprin gave the result of his examination of fossiliferous pebbles from near the East Park reservoir. Most of the fossils are barely recognizable as organic remains, but *Spirifer perlamilosus* could be identified. The formation represented by these pebbles is the Decker's Ferry sandstone connecting the Oriskany with the Lower Helderberg beds. This deposit extends in a south-western direction from about thirteen miles north of the Delaware Water gap. The same speaker also showed specimens of rock from New York containing particles and masses of serpentine closely resembling the so-called *Eozoon canadense*, yet with sufficient difference to show clearly that they were formed by mineral accretion. Professor Heilprin held that these specimens were enough to prove the non-organic nature of Eozoon.

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SOME NEW INFUSORIA.

BY ALFRED C. STOKES, M.D.

A BITTER November wind out of a gray sky. A river as gray and cold, a little foam on its surface where the rocks fretted it. A group of bare trees ankle deep in their own leaves on a low bank whence bubbled a rill that seemed the only happy thing in the dreary landscape, while a shivering pedestrian shed involuntary tears as he filled his bottle with wet leaves and with water from the brook. A gloomy prospect and a gloomy day, but for compensation that bottle held a potentiality of infusorial wealth beyond the dreams of avarice. Not a tithe of the wonderful forms developed from the germs in that natural infusion could be noticed without making a paper of wearisome extent. To enumerate the individuals would be impossible. I can only present a half dozen taken at random.

As the infusion stood through the winter in a covered vessel, to which not a single drop of water was added except by the condensation of its own vapor on the cover, a source of endless interest to the writer has been to observe the sudden disappearance of the creatures which, for a week or two, had swarmed among the leaves by the thousand, and the equally sudden coming, from unsuspected and unknown spores, of as great a crowd of entirely different, more complex and more highly organized animalcules. Those higher in the scale devoured the lower, it is true, and did it without ceremony; but many died and melted away as their favorite food became exhausted or, for some other problematic reason, their surroundings became inauspicious. For weeks microscopic fungi flourished until the surface of the water bore a jelly-like layer a quarter of an inch deep, and Hypotrichous Infusoria, so huge that they were distinctly visible to the unaided vision, sported there in leaderless regiments and cohorts. But even that collection of fungi and bacteria disappeared, and the

water at this writing is as clear and limpid and sweet as that of a mountain spring, and not one of those gigantic Hypotricha is left. Yet the bowl is still a crowded infusorial menagerie. And not the least interesting fact is that most of those that have died as well as the living are new to science.

The lowest of those to which I desire now to refer, and perhaps the least abundant in its habitat, is a new member of the genus Atractonema, the threaded spindle, of Stein. Hitherto but one species has been observed, and that only by its discoverer. With it the body is much more fusiform than with this American animalcule, but the latter possesses all the generic characters of its foreign relative, and others which mark it as specifically distinct. The mouth in both is conspicuous, being especially so in this new form. The pharyngeal passage it is scarcely possible to overlook since it seems to communicate directly with the contractile vesicle. Whether the food passes into the pulsating vacuole, or through it, or to one side, are questions of interest that, so far as I am concerned, remain unanswered, as the creature has refused to take food when on the microscope stage. The single flagellum arises within the pharyngeal passage, a point on the wall, presumably the roof, serving as the basis of attachment. This structural feature is not mentioned, and probably does not exist in *Atractonema teres* Stein. The motion of the flagellum is very rapid, consisting of oscillations which give it the appearance of a figure of eight. That it is held stiffly coiled in that position and then vibrated, as is represented in the sketch (Fig. 1), I have been unable to determine. It has been engraved in that position because I desired to show the animalcule in its characteristic swimming attitude. When the Atractonema has been poisoned, preferably by iodine, preferably, of course, so far as the observer is concerned, the flagellum is uncoiled and straightened. The figure of eight aspect may therefore be illusory.

FIG. 1.—*Atractonema tortuosa*, sp. nov.

The animalcule's movements are by rapid writhing and twisting, at the same time rotating on its long axis. It is not changeable in shape, preserving its elongate, subcylindrical, somewhat vermicular form, except when in the agony of a toxicological death. It then coils and contorts itself like a wounded snake, temporarily flattening and expanding the body to a film. The character of the numerous dark-bordered

corpuscles within the endoplasm I do not know. *Chilomonas paramœcium* Ehr., for a long time the prevailing animalcule in the infusion, contains similar bodies which, under the influence of iodine, become intensely blue, and are therefore probably amylaceous. Those within Atractonema, under similar circumstances do not so change. The reproduction of the European species is by longitudinal fission. Multiplication of the American form has not been observed. Fig. 1 and the following description will probably be sufficient for diagnosis:

Atractonema tortuosa, sp. nov.—Body elongate, subcylindrical, soft and flexible but persistent in shape, seven to ten times as long as broad, tapering and pointed posteriorly, the anterior extremity narrowed, the frontal border truncate; oral aperture terminal, conspicuous, followed by a tubular pharyngeal passage apparently connected by its posterior termination with the spherical contractile vesicle; flagellum single, vibratile, about one-half as long as the body, issuing from the oral aperture and taking its origin from the wall of the pharynx at some distance from the frontal margin; nucleus ovate, placed behind the body-center; endoplasm colorless, transparent, enclosing numerous, oblong, dark-bordered corpuscles; movements tortuous and rotatory on the long axis. Length of body $\frac{1}{600}$ to $\frac{1}{325}$ inch. Habitat: a vegetable infusion.

In the *American Journal of Science* for July, 1884, the writer described two new species of fresh-water infusoria under the generic title Solenotus, which was subsequently ascertained to be preoccupied in the Hymenoptera. Consequently, in the August number of the same journal, the name was changed to Notosolenus, the two members of the genus then being *Notosolenus (Solenotus) apocamptus* and *N. orbicularis*. The chief characteristics, aside from the persistent shape and an oral aperture, are the presence of a very short and inconspicuous trailing flagellum on the convex or ventral surface, and a longitudinal depression traversing the dorsal aspect, the infusorian thus appearing to swim on its back, since that part is expected to be more or less convex. Here, however, it is the ventral surface that is rounded.

When these animalcules were first obtained, although an anal aperture was observed and its location recorded, an oral orifice was not noted, and the systemic position of the infusoria was assumed to be among those forms which take food through any point on the surface, and near to Stein's Colponema. Since then, however, numerous specimens of both species have been observed, and although an oral aperture has not been actually discerned, yet the appearance of what seems to be a short pharyngeal tract is so constantly present that an oral orifice probably exists, and

the animalcules must therefore demand admission to the Flagellata-Eustomata of Saville Kent. The indurated character of the cuticular surface and the presence of green particles, apparently of food, within the endoplasm, would indicate the existence of a special mouth which would also be indirectly suggested by the appearance of the anal opening. The place of the genus in a systemic arrangement would therefore probably be, not in the neighborhood of Colponema but near Dujardin's Anisonema, differing from the latter, so far as the flagella are concerned, in having the shorter the trailing one, and the longer the vibratile, the converse of this being characteristic of Anisonema.

In the infusion a third species of Notosolenus has appeared. It is much depressed and almost triangular in form, the sloping sides being somewhat concave or undulate, and the truncate posterior extremity more or less emarginate, this emargination in some individuals increasing to a strongly marked concavity. Fig. 2 represents the creature in its ventral aspect with the extremity moderately uneven, and Fig. 3 another individual with a conspicuous emargination. Its endoplasm is very bright and transparent, being obscured only in the posterior part by granules and

Fig. 2.

Fig. 3.

FIG. 2.—*Notosolenus sinuatus*, sp. nov., ventral. FIG. 3.—*N. sinuatus*, emarginate form, ventral.

food particles. Its movement is forward in an almost direct course, the body elevated, the anterior apex in contact with the slide, the long flagellum held stiffly and obliquely in advance, its free end only vibrating, while the short flagellum, which appears to be of but little practical advantage to its owner, trails almost motionless below or above, for whether the animalcule shall float with the dorsal surface upward or beneath seems immaterial. It

advances across the field of view, stopping at any collection of débris in its path, examining it for food and departing with sudden turns and reversals of its course. The appearance of a pharyngeal tract is here more clearly defined than in the other species, and the infusorian is by far the largest of those hitherto observed.

Notosolenus (*Solenotus*) *sinuatus*, sp. nov.—Body depressed, broadly and irregularly ovate or subtriangular, somewhat longer than broad, widest posteriorly, gradually tapering through the posterior two-thirds, thence rapidly narrowing to the rounded frontal margin, the lateral borders frequently concave or undulate, the posterior extremity truncate, more or less emarginate; dorsal depression narrow, deep, with an anterior keel-like elevation; ventral surface smoothly convex; long flagellum vibratile at its distal end only, somewhat less than twice as long as the body, held stiffly and obliquely in advance towards the right-hand side; short or trailing flagellum about one-half as long as the body, usually extending obliquely backward toward the right-hand border; nucleus apparently single, spherical and near the center of the left-hand side, the contractile vesicle in front, and near the opposite margin; endoplasm colorless, transparent, posteriorly enclosing granules and green particles. Length of body $\frac{1}{1125}$, greatest width $\frac{1}{1500}$ inch. Habitat: standing water, with dead leaves.

When the growth of fungi and bacteria on the water was near its height, a Paramœcium appeared in profusion. It seems to be a distinct species, and one that can scarcely be mistaken for any known form, except possibly for *P. bursaria* (Ehr.) S. K., differing from the latter, however, conspicuously in form, especially in the apparently oblique curvature of the anterior extremity, in the absence of the truncation of the same part, the absence of the rapid and continuous circulation of the endoplasmic contents, and particularly the green coloration of the cortex and sarcode. The oral aperture of the form I have named *Paramœcium trichium* is at the posterior extremity of the deep adoral fossa which gives the front part the appearance of being folded toward the left, and is followed by a distinct, ciliated pharynx (Fig. 4). The two contractile vesicles, instead of being placed one in each body-half, as in *P. bursaria*, are here anterior and close together, contracting quickly, the one beginning to reform almost before the completion of the other's systole. Trichocysts are very abundant, and are so arranged that they seem to elevate the cuticular surface into the minute hemispherical bosses that cover the entire

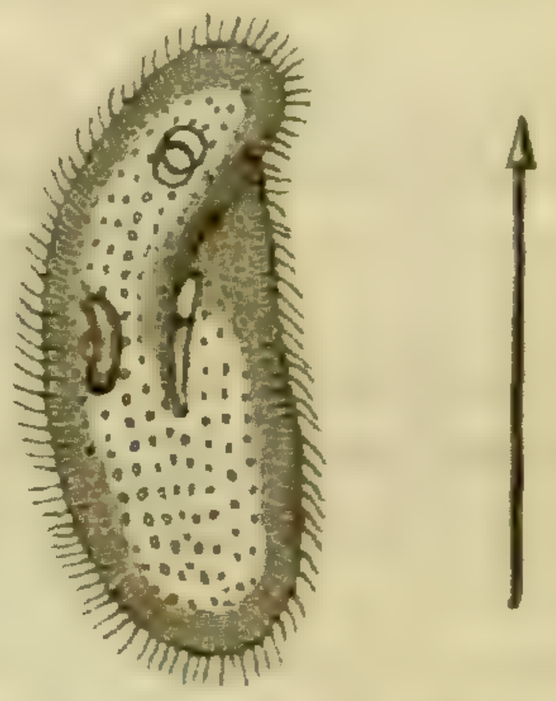


Fig. 4. Fig. 5.

FIG. 4. — *Paramœcium trichium*, sp. nov., ventral. × 450. FIG. 5.—Trichocyst.

body. When forcibly extruded through the influence of the glycerole of tannin, the distal end of each, for about one-tenth of the entire length, is conspicuously thickened, so that the trichocyst seems to be supplemented by the addition of a minute pyramid (Fig. 5). Occasionally, before the animalcule's death, when suffering from the application of a very dilute solution of the glycerole, it then gradually assuming an evenly ovoid form and becoming pale and ghostly, and always after the extrusion of the trichocysts and their removal from the body, the cuticular elevations are replaced by equally minute, regularly disposed, parallelogrammic depressions, as if the escaping trichocysts had left empty spaces which were filled by the sinking of the cortex. The nucleus and nucleolus are not always constant either in relation to each other or to a special part of the body. The former is sometimes, and normally it would seem, subcentrally located, yet sometimes being near the dorsum, again nearest the ventral surface, and still again in the anterior extremity, being seldom seen behind the body center. The laterally attached nucleolus is almost as uncertain in its relative connection with the nucleus, becoming at times entirely detached.

Conjugation has been observed, union taking place between the latero-ventral surfaces. Reproduction is by transverse fission, the nucleus previously becoming much elongated, the dividing plane passing through its center. In some instances, soon after the beginning of genetic union, the nucleus assumes a finely striated appearance, gradually growing more and more indistinct in contour until it finally becomes indistinguishable from the surrounding endoplasm.

Paramœcium trichium, sp. nov.—Body soft and flexible, ovate, somewhat compressed, three times as long as broad, widest and slightly inflated posteriorly, both extremities rounded, the ventral surface somewhat flattened; adoral fossa extending to the center of the ventral aspect from the left obliquely toward the right, deepest and widest anteriorly, this part of the body apparently folded obliquely toward the left-hand side; oral aperture followed by a distinct, tubular, ciliated pharyngeal passage; trichocysts abundant, arranged vertically and apparently elevating the cuticular surface into the numerous, parallel, longitudinal series of minute hemispherical projections roughening the entire body and giving it in optical section a crenulated outline, their distal extremities, when forcibly extruded, conspicuously and pyramidally thickened; nucleus ovate, usually subcentrally placed, with a laterally attached nucleolus; contractile vesicle double, spherical, anteriorly located; anal aperture ventro-terminal. Length of body $\frac{1}{300}$, of trichocysts $\frac{1}{1000}$ inch. Habitat in the jelly-like mass of fungoid and bacterial growth on the surface of an infusion of dead leaves.

Attached to the sides of the vessel, to fragments of leaves or indeed to almost any basis of support, were many mucilaginous, coarsely granular zoocytia formed and inhabited by an animalcule generically distinct from all previously known infusoria. The sheath or zoocytium is very soft and shapeless, and variable both in size and in number of its occupants. It appears to be formed primarily by a thin exudation from the creature's body that would be nearly invisible were it not for the extraneous particles, spores, bacteria and débris of all kinds that adhere to the surface, and especially for the zoöid's excrementitious matter which seems to be the principal building material and the cause of the coarsely granular aspect. It is not uncommon to find a small colony produced by the mutual union, and probably by a mutual formation of adjacent zoöcytia, the resultant of this adhesion being a non-descript mass of flocculent matters from under shelter of which the animalcules project, and when startled by the approach of a larger infusorian, or from other cause, quickly glide backward to the posterior part of their semi-transparent dwelling. These zoöcytia are frequently attached to vegetable fragments or to masses of residual detritus so that they would be an almost indistinguishable part of the granular aggregation were it not for the presence of the living infusorian. Indeed, when deserted these formations cannot be separated by the eye from other flocculent clusters so often in the field. Yet the creature forms them, apparently involuntarily, for soon after a frightened zoöid comes to rest, rejected particles in the food-bearing current begin to mark the outlines of the mucilaginous excretion which soon increases in size by the adhesion of everything that touches it.

The infusoria (Fig. 6) are ovate in form and entirely ciliated. The oral aperture is at the posterior extremity of a median depression occupying the anterior one-third of the ventral surface and bearing on its right-hand margin a row of curved, cirrose cilia. From the frontal border projects a cluster of long, distally curved hairs which by their constant and rapid downward lashing, force a current into the adoral groove and against the row of strong non-vibratile cilia on

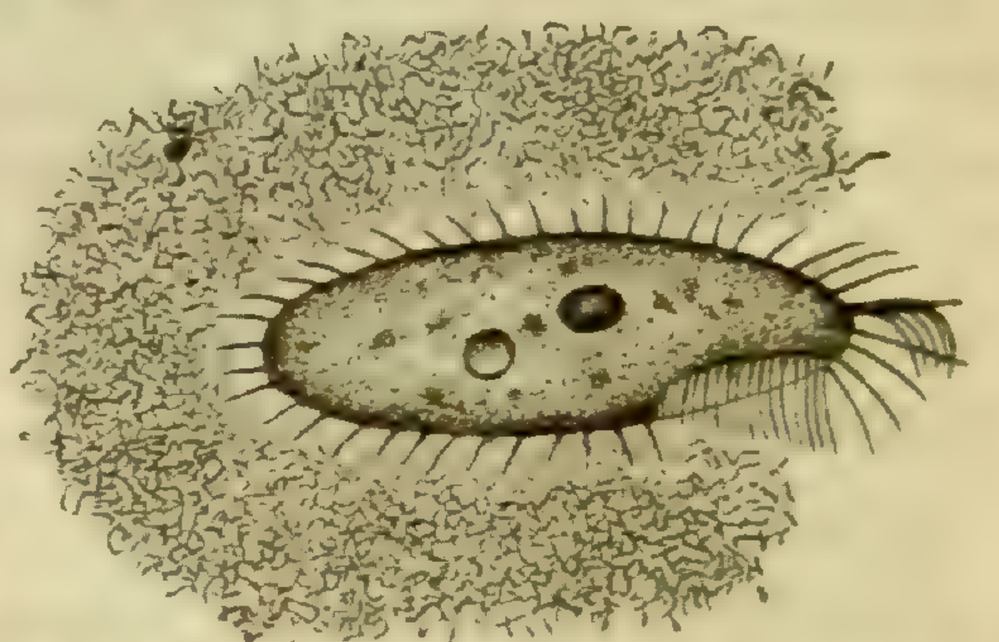


Fig. 6.—*Cyrtolophosis mucicola*, gen. et sp. nov.

the right-hand side of the mouth, thus supplying that ever-ready mouth with food. On such occasions the surface cilia behind the position of the oral aperture are in only irregular and uncertain vibration, while those on the frontal border, including the curved fascicle, are in the most active motion, being only momentarily visible, the right-hand ciliary fringe, under an insufficient amplification, then presenting the aspect of a single short seta, or a narrow lip, projecting from the posterior angle of the excavation. When the zoöids have been for some time under the thin cover, they voluntarily leave the old zoöcytium, swimming rapidly and occasionly settling on the slide to form a new and equally structureless protective covering. If a convenient collection of miscellaneous débris is accidentally encountered, the wandering infusorian often takes refuge beneath it, there gliding backward when threatened, as it did so conspicuously in its original home, the long anterior cilia then streaming out at the front.

Cyrtolophosis (κυρτος, *curved*; λοφωσις, *wearing a crest*), gen. nov.—Animalcules ovate, persistent in shape, entirely ciliate, the adoral cilia differing from those of the general surface, the anterior extremity bearing a fascicle of long distally curved, vibratile hairs; secreting and inhabiting a variously modified, mucilaginous, granular zoöcytium, to which they are in no way attached and from which they may pass at will; oral aperture at the posterior extremity of an excavated, elongated groove, longitudinally traversing the anterior part of the ventral surface, bearing on its right-hand margin a series of cirrose, adoral cilia; nucleus and contractile vesicle single, conspicuous; anal aperture postero-terminal.

Cyrtolophosis mucicola, sp. nov.—Body ovate, two and one-half to three times as long as broad, both extremities rounded, narrowed anteriorly, the ventro-frontal border obliquely truncate; anterior cilia longest, those of the general surface setose, the anteriorly placed fascicle of distally and downwardly curved cilia conspicuous; adoral depression extending from the frontal border for one-third the length of the entire body; adoral cilia cirrose, curved, diminishing in length toward the oral aperture; contractile vesicle single, spherical, posteriorly placed near the right-hand lateral border; nucleus subspherical, subcentrally located. Length of body $\frac{1}{900}$ to $\frac{1}{1000}$ inch. Zoöcytia solitary or variously united. Habitat: an infusion of dead leaves. Reproduction by transverse fission.

Another infusorian, bearing a carapace and having the adoral fringe on the left-hand margin of the peristome, and therefore undoubtedly a member of the Euplotidæ, proved to be an undescribed species of the curious Euplotes, animalcules whose ventral styles are not only used for swimming but as ambulatory organs. They are often seen walking over the slide and among the masses of débris usually present, apparently swimming only when food is exhausted in that locality and they must journey

further to seek it. The form now referred to differs from all others in the number of the frontal styles, the character and arrangement of the anal styles and caudal setæ, and in the shape of the carapace, which has a very conspicuous keel or high acute ridge traversing the dorsum from the frontal to the posterior borders. In Fig. 7 is shown the ventral aspect with the ambula-

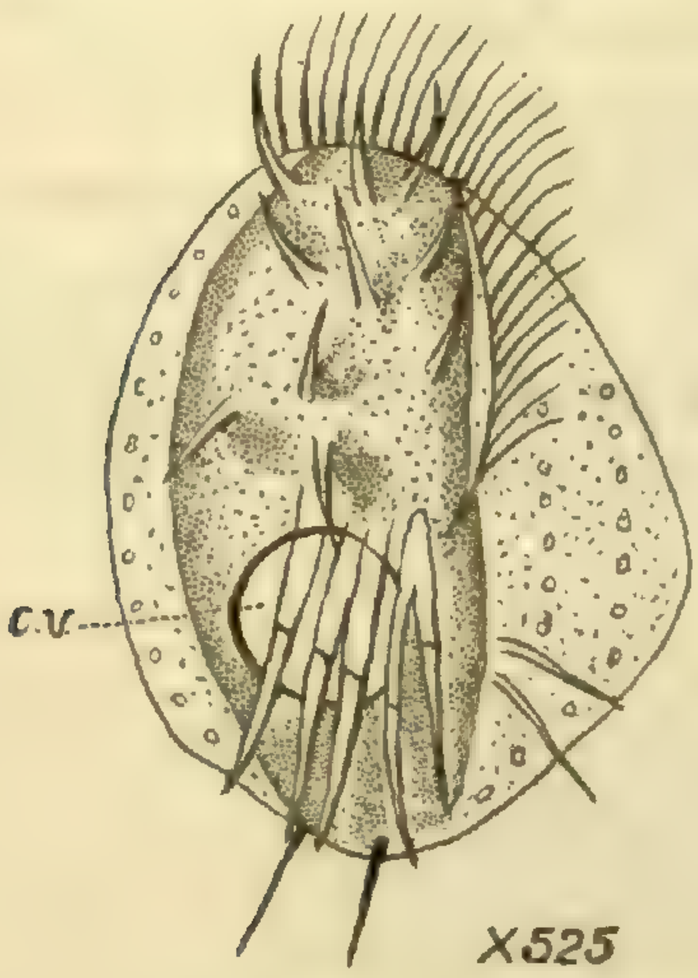


Fig. 7.

Fig. 8.

FIG. 7.—*Euplotes carinata*, sp. nov., ventral aspect. FIG. 8.—The same in dorsal aspect.

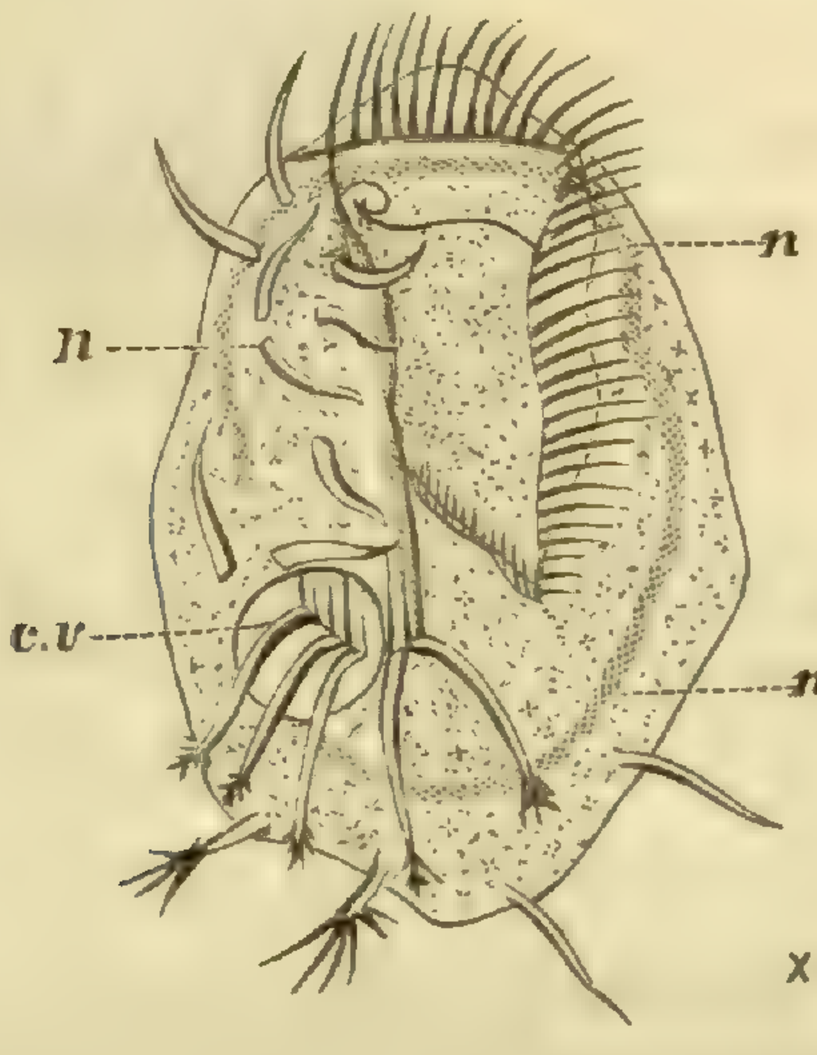
tory organs and setæ; in Fig. 8 the upper surface of the carapace with the central keel that suggested the specific name.

Euplotes carinata, sp. nov.—Carapace irregularly suborbicular, the frontal and right-hand borders evenly rounded, the posterior margin convex and usually emarginate on the right-hand side, the left-hand border rounded but obliquely truncate in opposite directions, thus forming a subcentral rounded protruding angle; dorsal surface traversed by a single conspicuous median and longitudinal keel or acute ridge, and by four to six longitudinal furrows; seven frontal, three scattered ventral and five straight simple anal styles; four unbranched caudal setæ, the two on the left-hand side close together but remote from the margin; peristome-field narrow, arcuate, the posterior third of the right-hand border ciliated; nucleus band-shaped, long, semicircular. Length of carapace $\frac{1}{376}$, greatest width $\frac{1}{500}$ inch. Habitat: standing water with dead leaves.

In the *American Monthly Microscopical Journal* for Dec., 1884, the writer described a Euplotes under the specific title of *plumipes*, so naming it on account of the beautifully fimbriated condition of the anal styles; but the figure there published represented a few of the adoral cilia in an incorrect position. Through the kindness of Dr. Packard I am able to present here a corrected drawing (Fig. 9) of the same interesting infusorian with the description. My pleasure in doing so is increased not only by the

opportunity to correct my own oversight, but because I can again ask attention to one of the most beautiful American members of the genus.

The carapace of *E. carinata* is somewhat irregularly marked by small circles formed of minute dots visible through the transparent borders. This ornamentation is variable, however, as is probably the case in all the decorated species, the dots becoming scattered, leaving the little circles incomplete or even entirely destroying them. This variableness in the surface adornment is also apparent in *E. plumipes*, but there, when most completely developed, the ornamentation consists of oblong elevations arranged in stellate clusters which are sprinkled quite regularly in



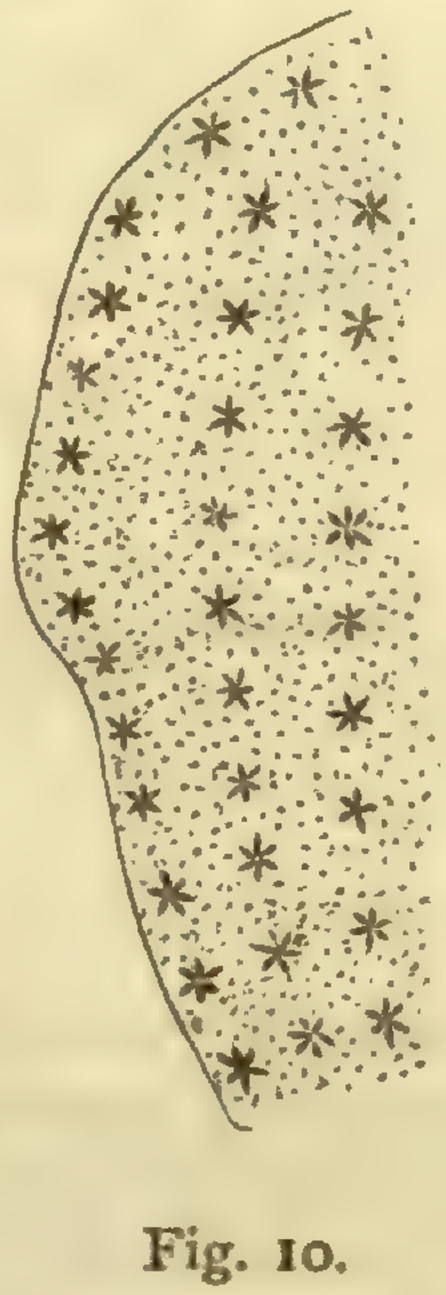


Fig. 9. Fig. 10.

FIG. 9.—*Euplotes plumipes* Stokes. FIG. 10.—Ornamentation of the carapace.

longitudinal lines over a surface already roughened by minute dots. The result is very pleasing to the eye, and adds another item of interest to the infusorian which seems to be one of the bravest and most self-reliant of its class, walking or swimming boldly and steadily forward as if with some object of vital import in view. This ornamentation is shown in detail in Fig. 10.

Euplotes plumipes Stokes.—Carapace irregularly suborbicular or elliptical, the anterior margin truncate, often minutely crenulate or beaded, the upper lip crescentic and conspicuously projecting; posterior margin rounded, usually with a shallow emargination on the right-hand side of the median line; right-hand border rounded or somewhat flattened and undulate; the anterior and posterior halves of the left-hand border commonly obliquely truncate in opposite directions and forming centrally a projecting and rounded angle or keel-like protuberance; peristome field

wide, triangular, the upper right-hand corner prolonged in a sinistrally directed helicoidal curvature, posteriorly extending beyond the center of the ventral surface, the cilia of the anterior and left-hand borders large and cirrose, the posterior third of the right-hand margin ciliated; six frontal, three ventral and five anal styles, the extremities of each of the last finely fimbriated; caudal setæ four, the two on the right-hand side of the median line much branched; dorsal surface convex, without longitudinal furrows, minutely roughened and often ornamented by longitudinal rows of equidistant elevations formed of minute prominences arranged in stellate clusters; nucleus band-like, curved, very long, extending around nearly the entire periphery, its extremities separated by a short interval near the right-hand body margin; anal aperture in close proximity to the contractile vesicle. Length of carapace $\frac{1}{200}$ inch. Habitat: pond water, near the bottom.

Conjugation is accomplished through the union of two individuals by the left-hand half of the ventral surfaces, and multiplication is by transverse fission. The first apparent change preceding the latter act is the development of a series of cilia almost parallel with the left-hand margin of the peristome, while from the comparatively vacant space over which the ventral styles are scattered, the zoöid gradually extrudes fourteen new styles, a second contractile vesicle appears, and the infusorian then presents the interesting aspect of a Euplotes with a double row of adoral cilia, two pulsating vacuoles, four caudal setæ and twenty-eight ambulatory styles. The body quite rapidly elongates until about twice the ordinary length, and separates across the middle, distributing the twenty-eight styles so that the anterior moiety preserves the old frontal and ventral ones, taking five of the new for its anal supply and extruding four fresh caudal setæ. The posterior portion therefore has the newly formed frontal and ventral and the old anal styles, with the old caudal setæ. But before the final separation the posterior animalcule extrudes four additional caudal setæ, then having twice as many as the normal complement, gradually and in irregular sequence absorbing the four old and now unwelcome and useless ones, those that are branched being the last to appear and the last to be absorbed.

KITCHEN GARDEN ESCULENTS OF AMERICAN ORIGIN.

I.

BY E. LEWIS STURTEVANT, M.D.

IN our leading seed catalogues some seventy-two species of plants are usually grouped under kitchen garden esculents. Of these we believe seventeen to be of American origin, the purslane doubtful, and chives to belong to both the old and the new world. Excluding these nineteen, De Candolle assigns, of the remainder, twenty-four to Europe, fifteen to Asia, four to Africa, one to Australasia and nine not mentioned. Of this list many have both European and Asiatic habitat, or other habitat as well as the one under which tabulated. If we compare the importance of the old and new world vegetables, we find it difficult to decide. Certainly the old world cabbage, in its numerous races, is of importance in the garden, but so is the new world potato. What can be decided, however, is that the peppers, pumpkin and squash, tomato, sweet corn and sweet potato are representatives of a culture which antedated their introduction into the gardens of Europeans, and must have been derived through a cultivation as careful as was required for the equal development of similar vegetables of old world origin. To expect to find the original of our longest cultivated vegetable products, as wheat or maize, in a plant that can now be recognized as a wheat or a maize, seems unphilosophical, as evolution must have long since produced changes during that long series of selections that have resulted not alone in producing varieties, but even races which deserve specific discrimination. On account of the light thrown upon an ancient civilization by the knowledge of the cultivated plants it has produced, I have thought fit to bring together a selection from my notes relating to the esculents of American origin which are now to be generally found in our vegetable gardens.

Alkekengi.—The alkekengi, or more usually called strawberry tomato in our seed catalogues, is *Physalis pubescens* L., an American plant which furnishes one of our minor vegetable products. This plant is said by Gray to be common southward and westward in the United States; and it is the *camaru* of Brazil.[1] It is

[1] Masters. Treas. of Bot.

described by Parkinson[1] under the name of *Halicacabum f. alk. virginiense*, and by Feuille[2] under the name of *Alkekengi virginianum fructu luteo*,[3] these names indicating its American origin. *P. peruviana* Hort., the *alkekengi of Peru* or *Capuli*, is cultivated in French gardens, but it differs but slightly from *P. pubescens*.[4] Pickering[5] says it is a native of tropical America, and has a Carib name, *sovsovrov-scoroo* (Desc.), and is called in Tagalo *potocan* (Blanco). Mueller[6] says *P. peruviana* L., is a native of temperate and tropical America, and is now naturalized widely in many countries of the warmer zone, a perennial, but in colder climates an annual. *P. barbadensis* Jacq., is another species sometimes cultivated in France[7] and a native of Barbadoes.[8] *P. mexicana* Vil., probably synonymous with *P. edulis* Sims., is grown in France, and the seed sold under the name of petite tomate du Mexique, according to Vilmorin (l. c.), but as grown at the New York Agricultural Experiment Station, it appears to answer to the description of *P. angulata* L. (var. ? *philadelphica* Gray ?), but the fruit larger than in the description. If this supposition be correct it was mentioned by Camerarius in 1588, Parkinson 1640, etc. Sloane mentions its occurrence in Jamaica.[9] Pickering[10] says it is a native of tropical America, but it seems to have a Malabar name, *inota inodien* (Rheede), Burmese *pungben* (Mason), Ylocano *tuttullacac* (Blanco), on Tahiti *tamani* (Bertero), on the Hawaiian islands *kamani*. Mueller[11] says it occurs in many tropical countries, extending as a native plant to the northern part of the United States and to Japan.

The old world alkekengi is *P. alkekengi* L., well known to the ancients, and described by Dioscorides. It does not now seem to be cultivated as a kitchen garden plant, having been superceded by the American species.

The fruit of the strawberry tomato is much esteemed by some

[1] Theatrum Botanicum, 1640, 462.
[2] Obs. faites sur les cotes orientales de l'Amerique meridionale, Paris, 1714–25.
[3] Miller's Dict.
[4] Vilmorin. Les Pl. Pot., p. 4.
[5] Chron. Hist. of Pl., 755.
[6] Select Plants, p. 165.
[7] Vilmorin. l. c.
[8] Miller's Dict.
[9] Lunan. Hort. Jam., II, 303.
[10] l. c., 429.
[11] l. c., 165.

people in a raw state or in preserves, and is disliked by others. It has a sweet acidulous taste with a pronounced flavor, considered by some as agreeable, by others as nauseous. It was not known in French kitchen garden culture in 1829 (not being mentioned in L'Hort. Francais, 1824–5, Nouv. Dict. du Jard., 1826, nor by Noisette, Man. du Jard., 1829), nor was the seed in the catalogue of Thorburn in 1828, which would indicate that it was not then in American gardens. *P. alkekengi*, according to Loudon,[1] was cultivated in most gardens in England till in the last century, and he says several other hardy species, including *P. pubescens*, also produce edible fruit. Alkekengi is described in several varieties or species by Burr in his American "Garden Vegetables," edition of 1863, but I have no opportunities of library conveniences to establish when our species first appeared in kitchen garden culture.

Bean: Kidney.—We have few vegetables as difficult to trace historically as the common bean (*Phaseolus vulgaris* Savi.), on account of the confusion which exists not only in the vernacular names customarily applied to this group of the Leguminosæ by common people, but also on account of the likeness which appears to exist between *beans* of various botanical genera. In a finely arranged museum collection of substances used in the arts, and arranged by a gentleman of unusual scientific attainments, I very recently was much surprised to recognize the *Soja* bean under the name "Beans from Japan," and also to recognize a variety of Dolichos under a similar mislabeling. The bean serves as a food, and is carried as provision from place to place without destruction of its value as a seed, and hence we should expect a more rapid and less recorded introduction to a new locality than is generally the case with a desirable vegetable, and this quick distribution is illustrated by the mention, by Josselyn, one of the early writers of New England, of the "American beans" of many kinds, and also Bonivis, Calavances and the "*kidney-bean that is proper to Roanoke*," and he adds: "But these are brought into the country; the others are natural to the climate."[2]

In De Candolle's writings upon geographical botany, he seems to ignore authors who might be quoted to fortify an opinion upon the American origin of plants, as his references show dependence

[1] Hort. Lond., 1860, p. 582.

[2] Josselyn's Voyages, pp. 73–74.

more upon botanical writers than upon mention by voyagers and historians. If we peruse the early accounts of American discovery, we find beans mentioned as of almost universal occurrence among the native tribes, but what bean was meant must be inferred from other data. In the north-eastern portion of America it is probable that such mention is of *Phaseolus vulgaris;* in the central portion, of this and some species of the Dolichos; further south, the Dolichos and lima are perhaps often included; in the south-west, the mesquit bean. All these sorts, whichever genus was intended, served as food for the traveler, and were doubtless, all but the mesquit, secured as provision by the many exploring vessels victualed in those times from the productions of the countries visited.

We have absolutely no certain information which leads us to suppose that *Phaseolus vulgaris* existed in the old world before the discovery of America. The only evidence we find is the early use of the word "kidney-bean" by voyagers, as when Columbus, in 1502, found "red and white beans, resembling the kidney-beans of Spain,"[1] but this is in a translation; or when Strachey says the beans of Virginia "are the same which the Turks call garvances;"[2] but Strachey was in Virginia in 1610, and before this the kidney-bean seems well known in Southern Europe. There is no certainty that it was known to the ancient Greeks and Romans. According to De Candolle[3] this bean is not among the numerous seeds that have been unearthed from the ruins of ancient Troy, nor has it been found in the lacustrine débris of the lakes of Switzerland, Savoy, Austria and Italy. There is no proof that it existed in ancient Egypt. It is not mentioned by ancient Chinese authors.[4] The authors of the fifteenth century, such as Crescenzio and Macer Floridus, do not speak of it. The authors of the sixteenth century, after the discovery of America, all publish figures and descriptions of *P. vulgaris* with an infinity of varieties.[5] Kidney-beans are stated to have been introduced into England in 1597, some say imported from the Netherlands as early as 1509.[6] *French beans* are, how-

[1] Knox. Coll. of Voy., 1767, I, 147.
[2] Strachey's Virginia. Hak. Soc. ed., 117.
[3] Origine des Plants Cultivées, 272.
[4] Bretschneider. On the study and value of Chinese botanical works, &c.
[5] De Candolle, l. c., 272.
[6] W. S. Booth, Treas. of Bot.

ever, mentioned by Barnaby Googe in 1572,[1] which name indicates their previous introduction into France. In 1640 Parkinson[2] says in his quaint form: "There hath come likewise unto us and others both from Africa, Brasill, the East and West Indies, Virginia, &c., sundry other sorts and varieties which were endless to recite, or at least useless, but onely to behold and contemplate the wonderfull works of the Creator in those his creatures." The mention of a Faseolus by Albert le Grand, which De Candolle takes to be a dwarf bean, may well apply to some species of Dolichos, probably *D. unguiculatus* L. There is no indication of an early introduction into India, as De Candolle remarks,[3] and Walter Elliot[4] says that *P. vulgaris* is not an article of field produce in Southern India nor of general use among the natives, its culture being confined to gardens near European settlements.

The evidence for the antiquity of the bean in America is both circumstantial and direct. The number of names given in the northern parts of America alone indicate an antiquity of culture, such as *sahe* or *sahu* on the St. Lawrence (Cartier), *ogaressa* by the Hurons (Sagard), *tuppuhguam-ash*, "twiners," by the Northern Algonquins (Elliot), *a'teba'kwe* by the Abenaki of the Kennebec (Rasle), *mushaquissedes* by the Pequods (Pres. Stiles), *malachxil* by the Delawares (Zeisberger), *okindgier* on the Roanoke, etc.; and in these few cases, for illustration, we find no common root. The number of varieties that were grown by the Indians are also another indication of antiquity of culture, but this fact of varieties will receive illustration in our quotations from early voyagers.

John Verarzanno, in a letter written in July, 1524, says of the Indians of Norum Bega: "Their ordinairie foode is of pulse, whereof they have great store, differing in colour and taste from ours, of good and pleasant taste." Evidently this first visitor to the New England coast had never seen kidney-beans previously.[5] In 1605 Champlain, writing of the Indians of the Kennebec region says: "With this corn they put in each hill three or four Brazilian beans (Febues du Bresil), which are of different colors. When they grow up they interlace with the corn which reaches

[1] Gard. Chron., 1864, 1181.
[2] Theatrum. Bot., 1058.
[3] l. c., p. 272.
[4] Bot. Soc. of Edinb., VII, 291.
[5] Hakluyt. Divers Voyages to Am., p. 61.

to the height of from five to six feet; and they keep the ground very free from weeds."[1] In 1614 Capt. John Smith mentions "beans" among the New England Indians,[2] and when the Pilgrims first landed, Nov. 19, 1620, Miles Standish unearthed from a pit not only corn but "a bag of beans." Wood also mentions "Indian beans" as among the foods of the Massachusetts Indians, 1629–33.[3] Lescarbot[4] says that the Indians of Maine, 1608, like those of Virginia and Florida, plant their corn in hills, "and between the kernels of corn they plant beans marked with various colors, which are very delicate: these, because they are not so high as the corn, grow very well among it."[5] The most complete enumeration of varieties are, however, given in Josselyn, before 1670: "French beans: or rather, American beans. The herbalists call them kidney-beans from their shape and effects: for they strengthen the kidneys. They are variegated much,—some being bigger, a great deal, than others; some white, black, red, yellow, blue, spotted: besides your Bonivis and Calavances, and the kidney-bean that is proper to Roanoke. But these are brought into the country; the others are natural to the climate."[6]

In 1535 Cartier, at the mouth of the St. Lawrence, found "beans of every color, yet differing from ours."

In 1609 Hudson, exploring the river which now bears his name, found within the limits of what is now Rensselær county, N. Y., "beans of the last year's growth."[7] In 1653 Van der Donck, in his Description of the Netherlands, says: "Before the arrival of the Netherlanders [1614] the Indians raised beans of various kinds and colors, but generally too coarse to be eaten green, or to be pickled, except the blue sort, which are abundant."[8] In 1633, De Vries "proceeded in the yacht up the [Delaware] river, to procure beans from the Indians."[9]

"Beans" were seen by Newport, in 1607, in ascending the James river,[10] but Heriot, in 1586, describes the *okindgier* of Vir-

[1] Champlain's Voy. Prince. Soc. ed., 64.
[2] The Disc. of New Eng. Peter Force Coll. of Tracts, II, 16.
[3] N. E. Pros., pt. 2, ch. 6.
[4] Hist. Nouv. France, 1612, 835.
[5] Quoted by Gray and Trumbull, *Am. Jour. of Sc.*, Aug. 1883, p. 132.
[6] Josselyn's Voyages, 73, 74.
[7] N. Y. Hist. Soc. Coll. 2d ser., I, 300, 325.
[8] Gray and Trumbull, l. c., 134.
[9] Hazard's Annals of Pa., 31.
[10] Pickering, Ch. Hist. of Pl. 575.

ginia, "called by us beans, because in greatness and partly in shape they are like to the beans in England, saving that they are flatter, of more divers colours, and some pied. The leaf also of the stem is much different."[1] In 1700–8 Lawson[2] says: "The kidney-beans were here before the English came, being very plentiful in Indian corn-fields. The 'bushel bean,' a spontaneous growth, very flat, white and mottled with a purple figure, was trained on poles. [This is undoubtedly the lima, as it answers to the description given to me by a very credible person who secured for me samples from a spontaneous plant in Florida, 'the trunk as large as a man's thigh, and the plant known for the past twenty-five years, some years yielding as much as fifty bushels of pods,' and the seeds smaller than the cultivated lima, very flat, white and mottled with purple.] Indian rounceval or miraculous pulse, so called from their large pods and great increase; they are very good, and so are the bonavis, calavances, nanticokes and abundance of other pulse, too tedious to mention, which we find the Indians possessed of when first we settled in America." [*Bonavis* is perhaps bonavista, a variety of bean sold by Thorburn, a New York seedsman, in 1828. The *bonavista* bean (Long) of Jamaica, is said to be *Lablab vulgaris; calavances* is the Barbadoes name for *Dolichos sinensis* L., as used by Long, a red bean; and *galavangher* pea is the Barbadoes name for *D. barbadensis* Mayc.] In A true declaration of Virginia, London, 1610, p. 12, "the two beanes [planted with the corn] runne upon the stalks of the wheat, as our garden pease upon stickes."

In 1528 Narvaes found beans in great plenty in Florida and westward,[3] and de Vaca found beans in New Mexico or Sonora in 1535. De Soto, 1539, also found beans in abundance,[4] and mentions that "the granaries were full of maes and small beans," but we have no clue to the species. Beans are also mentioned in Ribault's voyage, in 1562, as cultivated by the Florida Indians.

The mentions of beans in Mexico are frequent. The Olmecs raised beans before the time of the Toltecs, as Veytia informs us;[5]

[1] Pinkerton's Voy., XII, 595.

[2] Voyage to Carolina, pp. 76, 77.

[3] Cabeza de Vaca's Relation.

[4] A relation of the invasion and conquest of Florida (no title page).

[5] Hist. Antiq. de Mejico, I, 154.

beans were a product of the Nahua tillage ;[1] they are mentioned by Acosta ;[2] Alarcon speaks of their culture by the Indians of the Colorado river in 1540; Alvarado of their culture by those of the valley of del Norte in 1541 ; and Vinegas says *kidney*-beans were grown by the Indians of the Colorado river in 1758. The native Mexican name was *ayacotle*, according to Humboldt, and Bancroft says that they were the "*etl*" of the Aztecs, when boiled in the pod *exotl*.

In November, 1492, Columbus, in Cuba, found "a sort of beans,"[3] or "fields planted with faxones and habas very different from those of Spain,"[4] and red and white beans were afterwards seen by him in Honduras,[5] according to Pickering.[6] Oviedo says in Nicaraugua many varieties of beans are raised,[7] and Gray and Trumbull quote Oviedo as saying that on the island and on the main many bushels are harvested every year, and in the province of Nicaraugua they are indigenous, and a great number of bushels are produced yearly of these and of other *fesoles* of other sorts and different colors.[8]

The Indians of Peru, according to de Vega, had three or four kinds of beans called *purutu*.[9] Squier found lima beans in the mummy covering of a woman from the huaca at Pachacamac, Peru ;[10] and Stevenson also found beans in his exploration of Peruvian tombs which antedated the conquest.[11] Wittmack, who studied the beans brought from Peruvian tombs by Reiss and Strobel, identified the lima beans and also three kidney-beans with *P. vulgaris purpurens* Martens, *P. vulgaris ellipticus præcox* Alefield, and *P. vulgaris ellipticus atrofuscus* Alefield.[12]

In Chili Molina says that before the country was conquered by the Spaniards, "thirteen or fourteen kinds of the bean, varying but little from the common European bean, were cultivated by the

[1] Bancroft's Native Races, II, 347.
[2] Hist. de las Zud. Seville, 1590.
[3] Knox Coll. of Voy., I, 83.
[4] Gray and Trumbull, l. c., 130.
[5] F. Colomb., 28 to 90.
[6] Chron. Hist. of Pl., 375.
[7] Hist. Gen., I, 285.
[8] l. c., 131.
[9] Royal Com. Hak. Soc. ed., II, 358.
[10] Peru, 78.
[11] Travels, I, 328.
[12] De Candolle, Origine des Pl. Cult., 278.

natives. One of these has a straight stalk, the other thirteen are climbers."[1]

In the face of this evidence, which might be even more multiplied from my notes, it seems unreasonable in De Candolle to doubt the American origin of the common kidney-bean, and his conclusion as shown by his classing "Haricot Commun Phaseolus vulgaris" under "Especes d'un origine Completement inconnue ou incertaine" seems to show that with him more evidence is required in the case of American plants than to locate others which are of probably European or Asiatic origin.

Bean: Lima.—The lima bean is unquestionably of American origin, and De Candolle assigns its original habitat to Brazil, where the variety *macrocarpus* Benth., has been found growing wild.[2] Seeds have been found in the mummy graves of Peru, as by Squier[3] at Pachahamac, and by Reiss and Stubel at Ancon.[4] In Southern Florida the lima bean, the seeds, white blotched or speckled with red, is found growing spontaneously in abandoned Indian plantations,. and various forms are recorded by authors under specific names as found in America and other countries, as *P. bipunctatus* Jacq., *P. inamoenus* L., *P. puberulus* Kunth., *P. saccharatus* Macf., &c.,[6] *P. derasus* Schrank (Martens), *P. rufus*, Jacq.,[7] etc. In the mentions of beans by voyagers this form is not discriminated from the kidney-bean, and hence we cannot offer precise statement of its occurrence from such authorities.

It is now widely distributed. It has not been found wild in Asia, nor has it any modern Indian or Sanscrit name (De Candolle); Ainslie[8] says it was brought to India from the Mauritius, and is the *vellore* or *duffin bean* of the southern provinces. Wight says it is much cultivated, is seldom if ever found in a wild state, and the large podded sort is said to have been brought by Dr. Duffin from the Mauritius.[9] It is not mentioned by the early

[1] Hist. of Chili, 1, 91.
[2] Orig. des Pl. Cult., 275.
[3] Peru, 78.
[4] De Candolle, l. c., 273.
[5] Letter of W. S. Allen, Chocaluskee.
[6] De Candolle, l. c.
[7] Miller's Dict.
[8] Mat. Med., 1, 28.
[9] Icones Plant. Pl., 755.

Chinese writers,[1] but Louriero mentions it in Cochinchina in his day (1790). A dark red form came to Martens from Batavia, and an orange-red from farther India.[2] Schweinfurth found it in Central Africa,[3] Martens[4] received it from Sierra Leone, the form *bipunctatus* came from the Cape of Good Hope to Vienna,[5] and Martens received it from Reunion under the name *Pois du Cap*. As Jaquin wrote in 1770 this fixes its appearance in Austria, but it only first reached England in 1779.[6] The form *inamœnus* was considered by Linnæus to belong to Africa, but he advances, as De Candolle remarks, no evidence of this habitat, and we may remark that the slave trade may well be responsible for the transmission very quietly of South American species of food plants of convenient characters for ship use to the African coast. *P. derasus* Schrank, considered by Sprengel a variety of *P. inamœnus*, was found at Rio Janeiro.[7]

The lima bean is the scimetar podded kidney-bean and sugar bean of Barbadoes;[8] it was mentioned in Jamaica by Lunan;[9] it may have been "the bushel bean," "very flat, white and mottled with a purple figure," of the Carolinas in 1700–8,[10] as this description applies very closely to the lima beans now spontaneous in Florida. Two varieties, the "Carolina" or sieva and the "lima," were grown in American gardens in 1806. Eight varieties, some scarcely differing, are now offered for sale by our seedsmen: Vilmorin enumerates four for France; the speckled form occurs in Brazil[11] and in Florida; a black form (*P. derasus*) in Brazil; the blood red in Texas;[12] the dark red with light or orange ruddy spots in the Bourbon isles (Jacquin); the black white-streaked in Cochin China (Loureiro); and the large white, small white or sieva, the red, the white striped and speckled with dark red, and the green, in our gardens. In Central Africa but two seeds are

[1] Bretschneider, On the study and value of Chinese botanical works.
[2] Martens, Die Gartenbohne, 96.
[3] Africa, II, 254.
[4] l. c.
[5] Miller's Dict.
[6] Miller's Dict.
[7] Martens, l. c.
[8] Schomburgh, Hist. of Barb., 605.
[9] Hort. Jam., I, 434.
[10] Lawson, Voy. to Car., 76–77.
[11] Martens, l. c.
[12] Martens, l. c.

ever found in a pod,[1] in our most improved varieties five or even six.

Beans: Asparagus.—The asparagus bean has its popular character indicated by its other name, yard-long, indicating the extreme length of its pods, which often attain a length of two feet. It is the *Dolichos sesquipedalis* L., and is said to be a native of the West Indies and of tropical America, and I find no mention of other origin accredited to it. It was included in American seed catalogues in 1828,[2] and was described as a garden plant in America by Fessenden, 1828,[3] and in France by Noisette.[4] It is said to have been first introduced into England in 1781.[5] It may have been the "Indian rouncival, or miraculous pulse, so called from their long pods and great increase: they are very good" of Lawson, 1700–8, found on his journey to Carolina,[6] but the species was not named by Linnæus before 1762, by Reichard before 1772, nor by Jacquin before 1770–6. No varieties are now sold by our seedsmen, nor has any but the original form been described. My notes are very deficient regarding this species.

The name of asparagus bean is probably derived from the lack of membrane, and hence tender character of the pods, which are cooked and eaten as a string bean.

Bean: Scarlet Runner.—The culture of the scarlet runner, *Phaseolus multiflorus* Lam., is very modern. In Johnson's edition of Gerarde, 1630, it is said to have been procured by Tradescant; in Ray's time, 1686, it was grown for ornament; Miller, about 1750, was the first to bring it into repute in England as a vegetable.[7] In America it was mentioned by M'Mahon in 1806[8] as cultivated exclusively for ornament; in 1821 it is included by Thorburn among vegetables,[9] in 1828 the scarlet and white Dutch are both mentioned among garden vegetable seeds,[10] and in 1828 or before, both varieties with white or scarlet flowers were grown in France under the name Haricot d'Espagne.[11]

[1] Schweinfurth, l. c.
[2] Thorburn's Cat., 1828.
[3] New American Gardener.
[4] Man. du Jard., 1829.
[5] Miller's Dict.
[6] Voy. to Car., 76, 77.
[7] Miller's Dict.
[8] Am. Gard. Cal., 1806.
[9] Kalendar, 1821.
[10] Thorburn's Seed Cat., 1828.
[11] Noisette, Man. du Jard., 362.

The species is classed as American by Unger, and is described in 1635 under the name *Phaseolus puniceo flore*, by Jac. Cornuti, in his Canadensium Plantarum Historia, and in 1640 by Parkinson under the name of *P. flore coccineo*.[1] Four forms are described by Martens[2] under *Phaseolus multiflorus* Savi., two of these, the black and the white seeded, were cultivated by Titius in 1654 under the name *P. indicus flore miniato, semine negro* and *semine albo*, the names indicating a West Indian origin; one, the scarlet runner, was first mentioned by Cornuti, 1635; and the fourth, the *P. multiflorus bicolor* Arrabida, was first described in the flora of Rio Janeiro, 1827. It is now grown in gardens in Europe, and is mentioned for India by Firminger.[3]

But three varieties are known to our seedsmen, the scarlet runner, the seeds black mottled with dull lilac; the painted lady, the seeds brown mottled with creamy white; and the white or Dutch with white beans.

Cucumber.—One species of cucumber, *Cucumis anguria* L. (*C. echinatus* Moench., *C. angurioides* Roem., *C. sylvestris americanus, anguriæ folio* Pluk., &c., *C. asininus* Piso, according to Naudin) is considered to be of American origin by botanists from Tournefort down to our own day, and its habitat is given by Naudin as "Antilles, Continental Tropical and Sub-tropical America, Brazil, New Granada, South Florida." De Candolle[4] seems to think its American origin doubtful, and is disposed to refer it to tropical Africa. Naudin, the authority on Cucurbitaceæ, refers to this species the *quarerva ova*, or *C. asininus* of Piso, 1658, found wild in Brazil; Sloane, 1707,[5] evidently describes this or an allied species in Jamaica; Long, 1774,[6] speaks of it as growing wild there, and it is mentioned as growing plentifully there by later writers, as Lunan[7] and Titford.[8] In Barbadoes it is mentioned by Hughes, 1750, under the name "wild cucumber vine."[9]

"Cucumbers" are mentioned by a few of the early writers on American affairs. They were among the plants grown by the

[1] Miller's Dict.
[2] Die Gartenbohnen.
[3] Gard. in India, 151.
[4] Origin of Cult. Plants, 267, 441.
[5] Nat. Hist. of Jam., 1, 227.
[6] Jam., 801.
[7] Hort. Jam., 1, 254.
[8] Hort. Bot. Am., 100.
[9] Schomburgh, Hist. of Barb., 593.

companions of Columbus at Isabella island in 1494,[1] but these were undoubtedly from European seed. De Soto, however, found "Cucumbers better than those of Spain" in his invasion of Florida, 1539;[2] Cartier found "very great cucumbers" cultivated by the Indians at Montreal, 1535, the epithet *very great* indicating the European cucumber however. Perhaps the *cucumbers* cultivated by the Florida Indians, as mentioned by Ribault, 1562,[3] and those seen by Captains Amidas and Barlow in Virginia, 1584,[4] but not those seen in Virginia in 1609,[5] were this species. "Cowcombers" were also planted on the Bermudas in 1609.[6]

The "Concombre arada" is largely cultivated in some of the West Indies, and under the name "West India gherkin" appears in the catalogues of our seedsmen. It seems to have been introduced into French garden culture by Vilmorin in 1858, but it is mentioned as grown in France by Noisette in 1829; it was cultivated in England by Miller in 1753, but probably only as a botanical curiosity. It was in American gardens, as a pickle plant, prior to 1828.[7] The lack of its mention by early writers, and the circumstance of its being reported as wild only in the track of the slave trade, would throw doubts upon its American origin; on the other hand we seem to have fewer specific reasons for assigning its origin to Africa or elsewhere. For the present then it must be considered as an American plant.

Garlic, Leek, Onion, Chives.—Neither the leek, garlic or onion are American plants. It is curious, therefore, to observe that Cortes, on the authority of Humboldt[8] cites onions, leeks and garlic among the edibles found on the march to Tenochtitlan. "Onyons" and "garlicke" are also mentioned by Peter Martyr,[9] and also "Cibaioes and macoanes, like unto onions" in the West Indies.[10] The "wild leekes" formerly eaten by the New England

[1] Irving's Columbus, New York, 1859, I, 380.
[2] Portuguese Relacion, 44, 46.
[3] Hak. Soc. Vol. VII.
[4] Smith's Virginia, 1606, Park. Voy., XIII.
[5] A True Decl. of Va., London, 1610, p. 13.
[6] Newes from the Barmudas, Lond., 1613, 20.
[7] Thorburn's Cat., 1828.
[8] Nouv. Esp., 2d ed., II, 476.
[9] Decades, v, lib. III.
[10] Eden's Hist. of Trav., 1577, 142.

natives[1] is probably *Allium canadense* L., and these are now relished by the Maine Indians. This species also furnishes food to the Indians of the Northwest,[2] and with *A. cernuum* formed almost the entire source of food for Marquette and his party on their journey in 1674 from Green bay to Chicago (to use modern geographical locations). This species does not, however, extend to Mexico, and we do not find mention of species native to the West Indies which would explain P. Martyr's or Cortes' mention, although *A. gracile* Ait., the Jamaica garlic, might answer for one, for these old warriors were not very choice in their application of well-known names to newly discovered plants, if there was any apparent resemblance. We may only suppose that the introduction of these vegetables from the West Indies, where brought by the Europeans, to Mexico, may have preceded the appearance of the Spaniard.

The chives (*Allium schænoprasum*) occurs in America about Lake Huron, and is also wild in Temperate and Northern Europe, Siberia and Kamschatka.[3]

(To be continued.)

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THE LEMUROIDEA AND THE INSECTIVORA OF THE EOCENE PERIOD OF NORTH AMERICA.

BY E. D. COPE.

TWO distinct divisions are included in this article, because the material is not yet sufficiently complete to enable me to refer certain forms to the one rather than the other. The only characters on which the osteologist can rely in endeavoring to distinguish the two groups are these: First, the terminal phalanges of the Insectivora are compressed and curved, forming claws; while those of the Lemuroidea and of most other Primates are more or less flat, and at the extremity rounded and depressed,[4] or more or less like hoofs.[5] Second, the hallux or inner toe of the posterior foot is opposable to the others, a character dependent on the form of the entocuneïform bone of the tarsus, which has in that

[1] Josselyn's Rarities, 84.

[2] R. Brown, Bot. Soc. of Ed., IX, 380.

[3] De Candolle, Origin of Cult. Pl., 437.

[4] See AMERICAN NATURALIST, April, 1885, where the Condylarthra are referred, with the Quadrumana, to the Ungulata.

[5] The marmosets are exceptions, having true claws.

case a rounded distal extremity, forming part of a cylinder directed more or less fore and aft, for articulation with the metatarsus or proximal element of the great toe. In the Insectivora this structure is wanting, the inner toe being fixed in a position parallel with the others as in the Carnivora. In the Lemuroidea the position of the thumb or pollex is less different from what is seen in the Insectivora, than is the case with the posterior foot. In the true lemur the thumb is but little opposable, except in the genus Chirogaleus and some others. The distal end of the trapezium bone of the carpus with which the thumb articulates, does not form a part of a cylinder in the Lemur or in the Tarsius. When the thumb becomes opposable in the monkey proper, the thumb facet of the trapezium is not rounded, but is wide and a little concave. It is not till we reach the man-like opposable thumb of the anthropoid apes that we find this bone presenting to the thumb a semicylindrical face like that of the entocuneiform bone of the posterior foot.

The Condylarthra as I have pointed out,[1] must be regarded as a division of the order of Taxeopoda, along with the Hyracoidea, the lemurs, the monkeys and man. The difference between the hoofs of Phenacodus and the ungues of Lemur is too slight to admit of wider separation: and the other parts of the structure show an equal agreement. There is no trace of opposability of the hallux in Phenacodus however, nor any os centrale of the carpus, characters which show that the suborder Condylarthra and Lemuroidea are distinct. In the pollex or thumb of Phenacodus, however, there is a distinct indication of opposability, though it is not so well developed as in the genus Lemur. The basal articulation with the trapezium is narrow, but is directed partly fore and aft, so that the thumb looks inwards. Its power of flexure at the base has been slight, but the flexure at the base of the first phalange has been such as to make the end of the thumb quite opposable.[2] From the Condylarthra then we trace the order Quadrumana on the one hand, and the hoofed orders on the other.

In the following pages I will not attempt to distinguish which of the genera are lemuroid and which are insectivorous, since the ungual phalanges are yet unknown. An exception must be made in the case of the genus Pelycodus, where a single compressed

[1] NATURALIST, April, 1885. Primates and Taxeopoda are there regarded as nearly synonymous.

[2] See NATURALIST, 1884, Plate XXIX, for the skeleton of Phenacodus.

acute claw is known. This alone does not decide the question, since such a claw exists on the second toe of many Lemuroidea.

These animals are readily distinguished into three divisions or families by the number of their premolar teeth. There are four such teeth in the Adapidæ; three in the Mixodectidæ, and two in the Anaptomorphidæ. In the Adapidæ we have the most primitive type, and the one most nearly allied to the Condylarthra, from which they were probably derived. In the Mixodectidæ we have the dental formula of the existing lemurs, with a tendency in some of the genera to develop large cutting teeth in the position of incisors, thus approaching the aye-aye. In the Anaptomorphidæ, on the other hand, we find a dental formula like that of the Simioidea and Anthropoidea, or higher

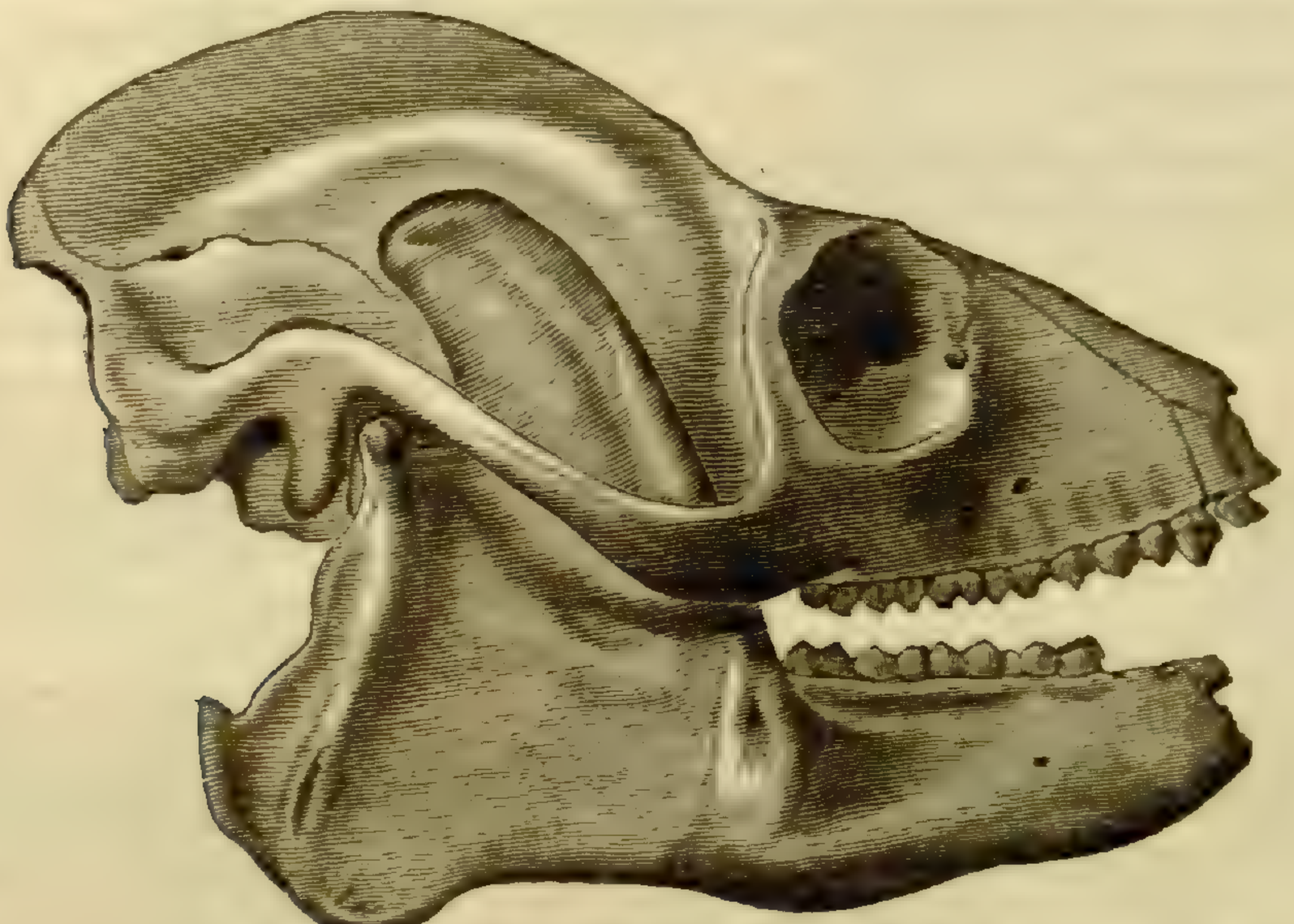

FIG. 1.—*Adapis parisiensis* Cuv., skull nat size, from the Phosphorites of Central France. From Filhol.

monkeys and apes; and in them we seem to get a hint of the derivation of these higher forms, and of man himself.

The genera of the Adapidæ are distinguished by various dental characters. Such are the presence of a second anterior-inner cusp of the inferior true molars; the presence of an internal cusp of the fourth inferior premolar; the number of incisor teeth, and number of single-rooted premolars. The difference between the quadrituberculate and the quinquetuberculate inferior molar may be understood by reference to Fig. 2, where the teeth of the genera Hyopsodus (*a*) and Microsyops (*b*), which represent the two types, are placed side by side.

In some genera, (Notharctus, Tomitherium, Figs. 4–5) the fifth cusp is present but weak. In others (Sarcolemur) it is repre-

sented by the anterior lobe of a twin or fissured anterior inner

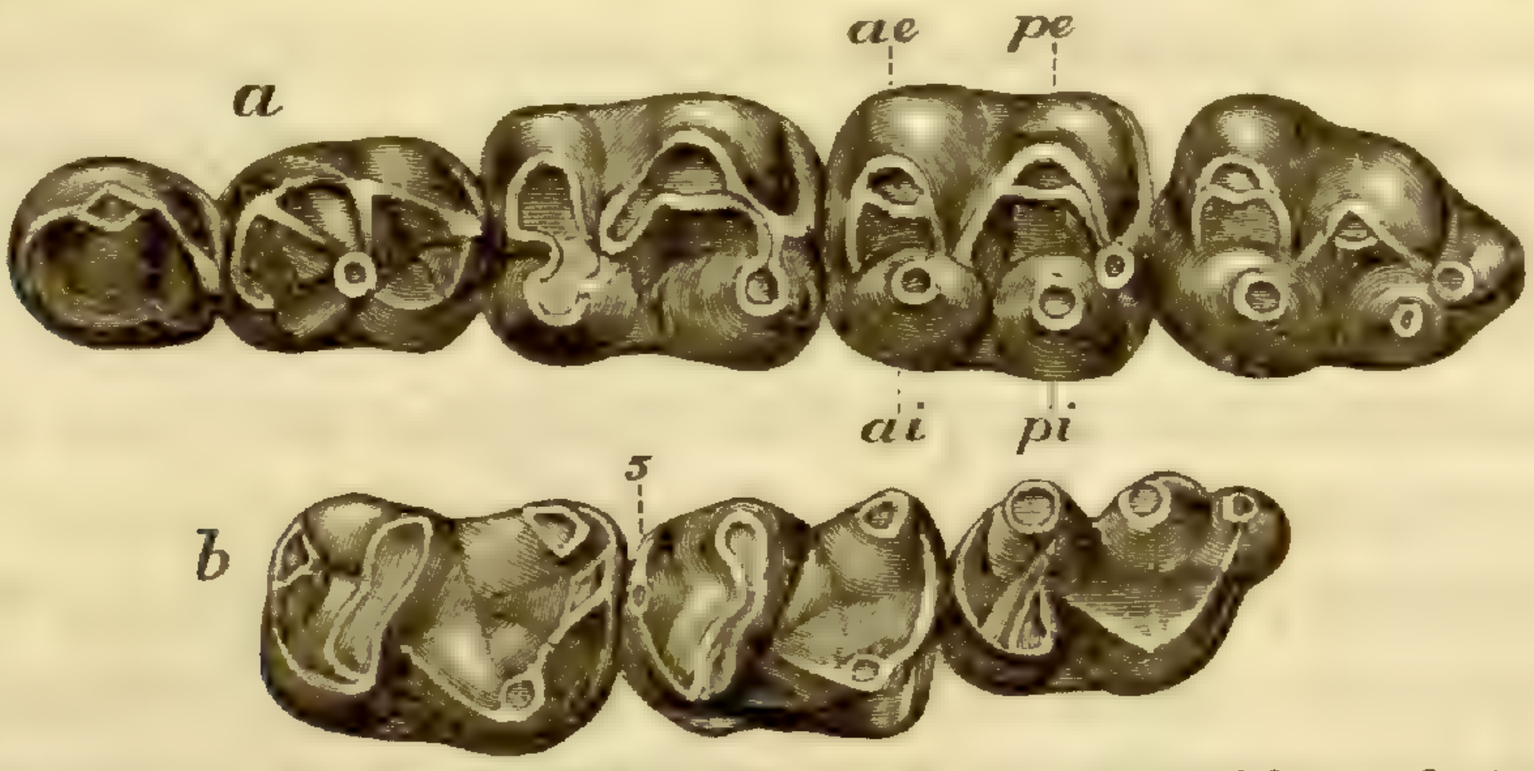

FIG. 2.—Inferior molar teeth of (*a*) *Hyopsodus paulus* Leidy, and (*b*) *Microsyops gracilis* Marsh; enlarged four times linear, from above. Fig. *ae*, anterior external cusp; *pe*, posterior external cusp; *ai*, anterior internal and *pi*, posterior internal cusp; 5 fifth or second anterior internal cusp. From Leidy, Report U. S. Geol. Surv. Terrs., F. V. Hayden in charge, Vol. I.

cusp. To simplify the understanding of these differences, I give the following table:

I. Inferior molars qadrituberculate.

Fourth inferior premolar with internal cusp: cusp on last molar opposite
Hyopsodus Leidy

Fourth inferior molar without internal cusp; cusps opposite .....*Apheliscus* Cope.[1]
Cusps of last molar alternate.....*Opisthotomus* Cope.

II. Inferior molars quinquetuberculate.

a. Anterior triangle not well developed on inferior molars.

Fifth cusp separated from anterior inner by an apical fissure only..*Sarcolemur* Cope.
Fifth cusp separated; canine distinct; one premolar one-rooted..*Notharctus* Leidy.
Fifth cusp well separated; canine distinct; two premolars one-rooted
Tomitherium Cope.
Fifth cusp separated, low; canine incisor- or premolar-like.....*Adapis* Cuv.

aa. Anterior triangle well developed on all the inferior molars.

Canine distinct; one premolar one-rooted.....*Pelycodus*[1] Cope.

Jaws of four species of Hyopsodus are abundant in the Wasatch and Bridger Eocene beds, and a species from the Puerco has been doubtfully referred to it. The best known species, the *H. paulus* Leidy (Fig. 2), of the Bridger epoch, has the jaws as large as those of a rabbit. The *H. vicarius* Cope, was smaller (Fig. 3). Nothing is known of the skeleton of any species of Hyopsodus. The only species of Apheliscus (*A. insidiosus* Cope) was found in the Wasatch beds of New Mexico. It has large teeth in the position of sectorials, and may be an aberrant Creodont. Nothing is known of it but jaws. Two species

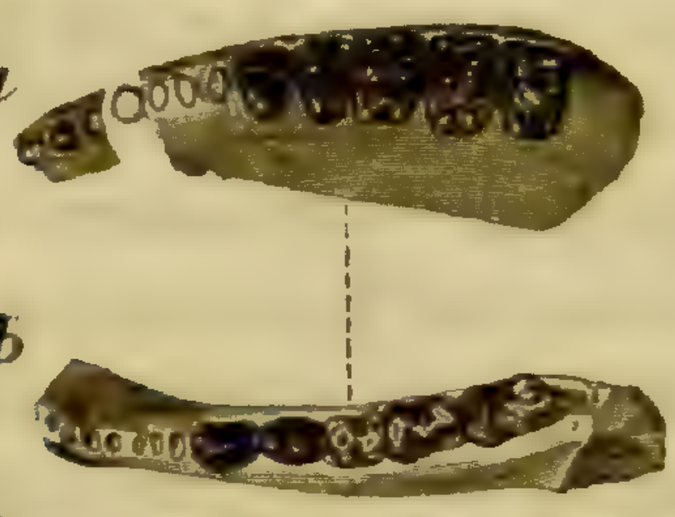

FIG. 3.—*Hyopsodus vicarius* Cope, jaws, from the Wind River (? Bridger) Eocene of Wyoming, natural size; *a*, superior, *b*, inferior dental series. Original, from Report U. S. Geol. Surv. Terrs., III.

[1] Of uncertain reference to this family and order.

of Opisthotomus are known from the same horizon and locality, from teeth only. The *O. flagrans* Cope is, with the *Adapis magnus* Filh., the largest species of the family. Sarcolemur Cope includes a single species from the Bridger beds, of the size of the *Hyopsodus paulus.* It has in its sharp dental cusps an effective biting apparatus.

In Notharctus Leidy, the fifth lobe of the true molars begins to be apparent, though it is only present in the first molar, where it is represented by the internal extremity of an anterior crest. The canine in this genus is well developed. Only one species is certainly known.

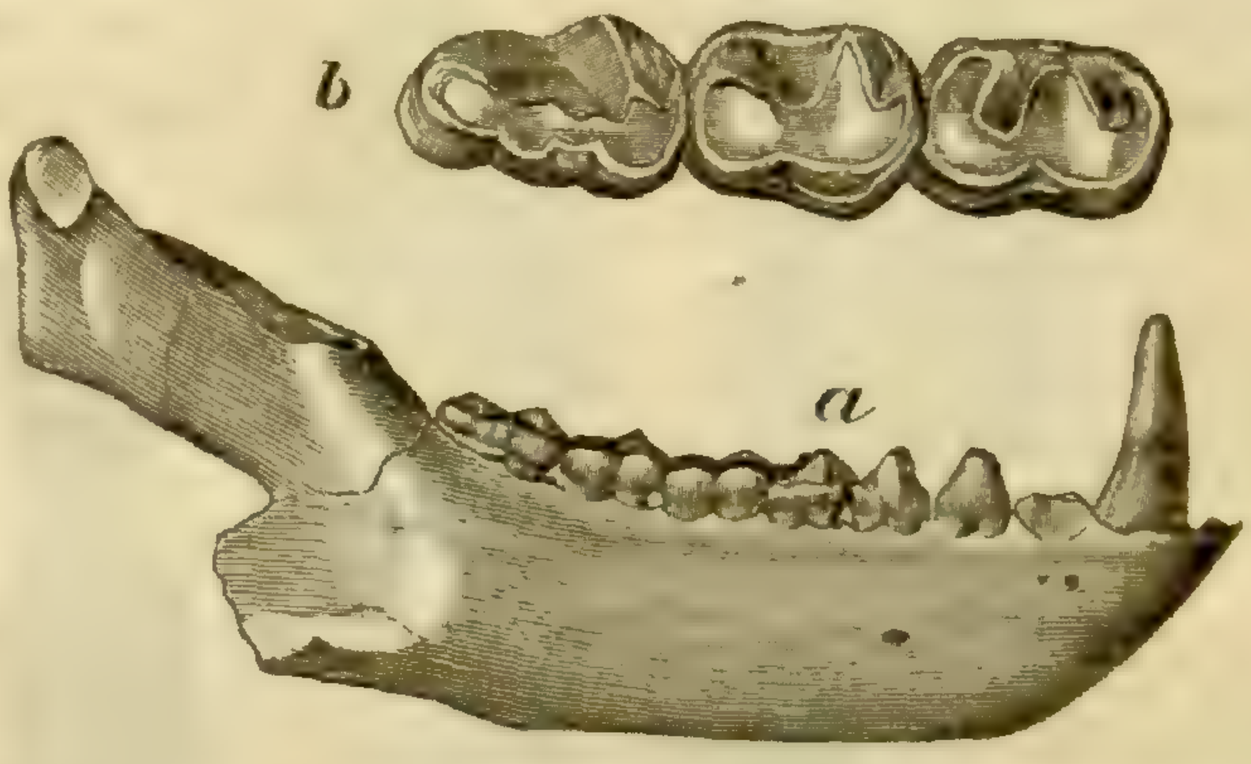

FIG. 4.—*Notharctus tenebrosus* Leidy. *a*, mandible from right side, natural size. Fig. *b*, true molars from above, twice nat. size, linear. From Bridger bed of Wyoming. From Leidy, Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol, I.

More of the skeleton is known in the genus Tomitherium Cope than in any other one of the family, and its relationship to the lemurs was thus indicated at the time of its original description in 1872. Unfortunately the ungual phalanges remain unknown. As in Hyopsodus and Pelycodus, there are but two inferior incisors in the lower jaw, and these have transverse cutting edges, and are not produced as in recent lemurs.

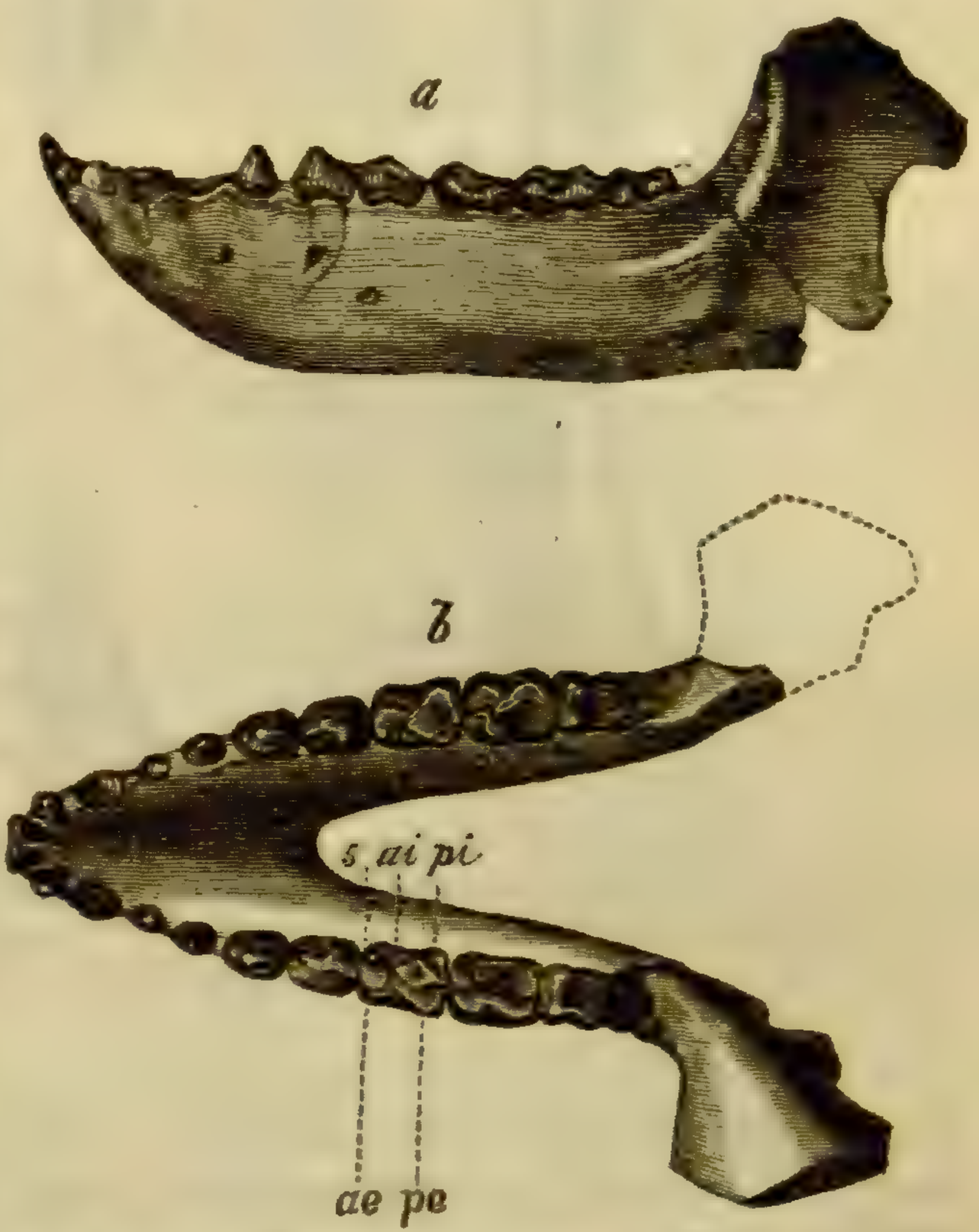

FIG. 5.—*Tomitherium rostratum* Cope, mandible natural size; *a*, from left side; *b*, from above. Letters as in Fig. 2. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

The first impression

derived from the appearance of the lower jaw and dentition, and from the humerus, is that of an· ally of the coati (Nasua). The humerus indeed, is almost a fac-simile of that of Nasua, the only difference being a slight outward direction of the axis of the head. The same bone resembles also that of many marsupials, but the flat ilium, elevated position of dental foramen, and absence of inflection of the angle of the lower jaw, etc., render affinity with that group highly improbable.

FIG. 6.—*Tomitherium rostratum* Cope, fore leg of animal represented in Figs. 5–7, nat size. Fig. *a*, humerus; *b*, ulna; *c*, radius, from front; *b′*, from side; *c″*, proximal end (artificially flattened below); *c‴*, distal end of radius. From Bridger beds of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., Vol. III.

The length of the femur indicates that the knee was entirely free from the body as in the Quadrumana, constituting a marked distinction from anything known in the Carnivora, including Nasua. The round head of the radius indicates a complete power of supination of the fore foot, and is different in form from that of Carnivora, including Nasua; and, finally, the distal

end of the radius is still more different from that of Nasua, and resembles closely that of monkeys of the genus Semnopithecus.

We have, then, an animal with a long thigh free from the body, a manus capable of complete pronation and supination, and details of lower jaw and teeth quite similar to those of the lower monkeys. The form of the humerus and its relative length to the femur are quite as marked as in some of the lemurs. The most marked difference is seen in the increased number of teeth; but in this point it relates itself to the other Quadrumana, as the most ancient types of Carnivora and Ungulates do to the more modern.

This genus is allied to Adapis Cuvier, of the French Eocene (Fig. 8), but differs in the possession of but two incisors on each side; in Adapis there are three, according to Filhol. From that genus and Opisthotomus, it differs also in the structure of the last inferior molar, as exhibited in the analytical table.

There are several species of Tomitherium, but the

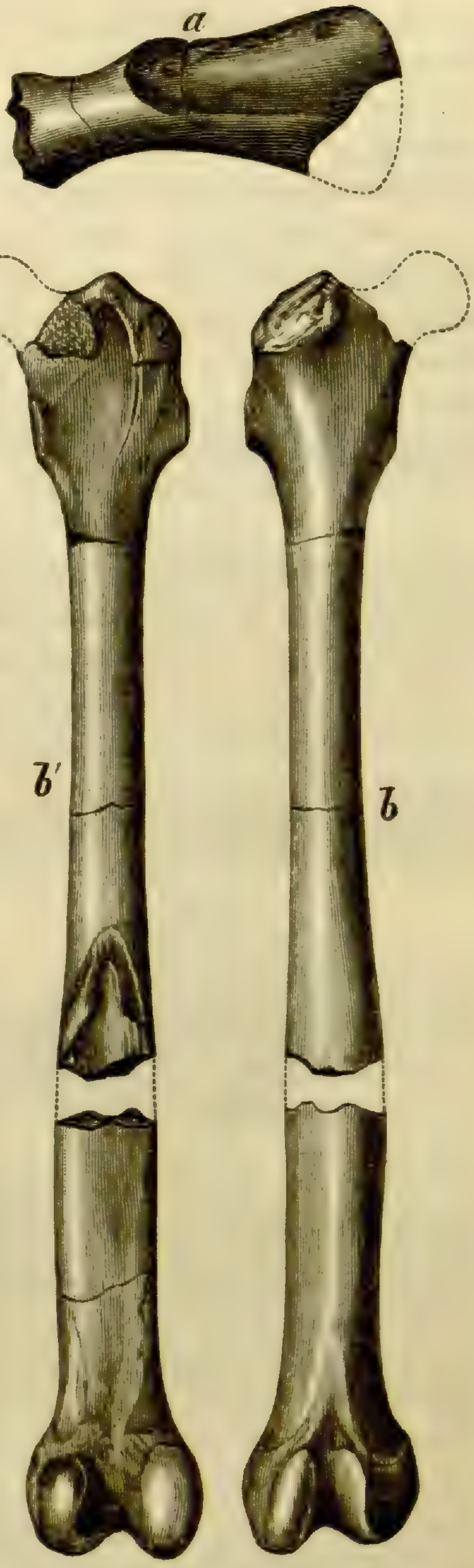

FIG. 7.—*Tomitherium rostratum* Cope, part of animal figured in Figs. 5–6, nat. size. Fig. *a*, ilium inner side; *b*, femur front; *b′*, do. posterior side.

best known is the *T. rostratum* from the Bridger formation of Wyoming.

The following points may be gained by comparison with the skeleton of *Lemur collaris* (catalogue Verreaux). There is considerable resemblance in the details of structure of the molars from the third to the sixth, inclusive. Of course the anterior teeth differ widely in the two, and the last true molar of the Lemur has no heel. The principal difference in the humeri is seen in the superior size of the epicondyles of the *T. rostratum*, and the rather more robust character of the shaft. The proximal half of the ulna is deeper, and the olecranon is not so wide in *T. rostratum*. The proximal part of the radius is very similar in the two species, but the distal extremity is in the *T. rostratum* less transversely extended, and thicker anteroposteriorly. There is also much similarity in the ilia. The crest is more extensive in *T. rostratum*, and the inferior border is thinner at its proximal part. Towards the acetabulum the increase in width of this border is similar, and the anterior inferior spine is as prominent. The resemblance between the femora amounts to identity of character; that of the *T. rostratum* is more robust.

The Mixodectidæ include four and perhaps five genera. In

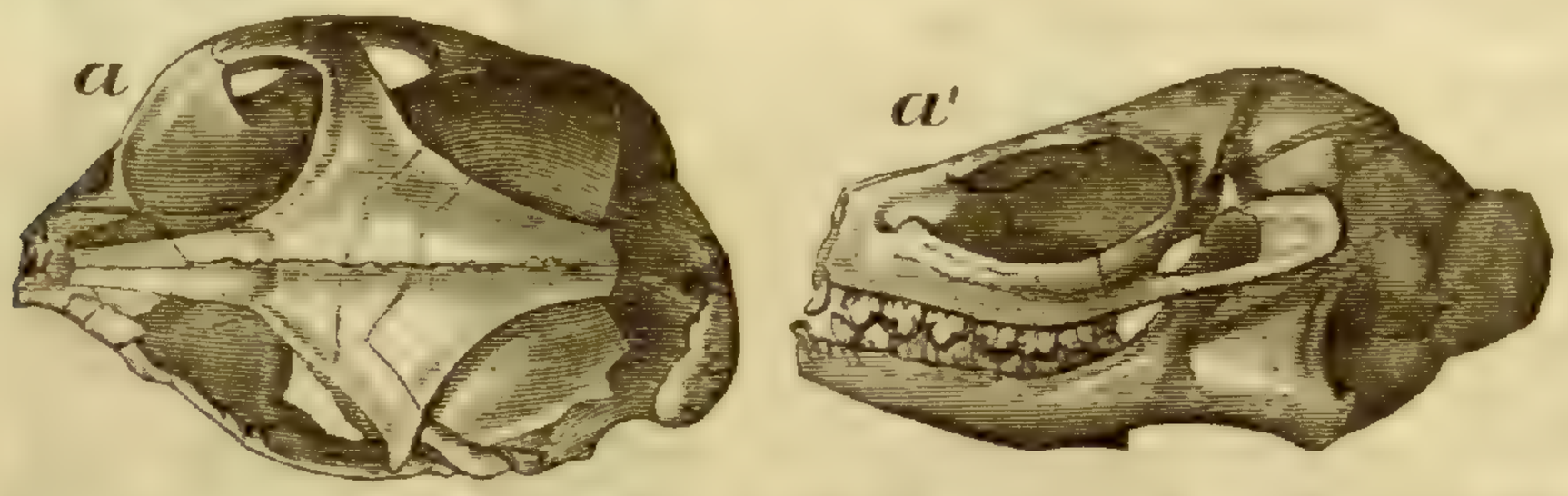

FIG. 8.—*Necrolemur antiquus* Filh., skull natural size, from Phosphorites of Central France. From Filhol Rech. s. les Phosph. de Quercy.

two of these the incisors have their usual position and space. One of these Tricentes Cope, has large canines well separated. It is uncertain whether the genus should not really be referred to the Creodonta.[1] It contains three or four rather small species from the Puerco formation of New Mexico. In Necrolemur the canine is insignificant. One species of the genus, the *N. antiquus* Filhol, is known. It is represented by a cranium in excellent preservation (Fig. 8) which has been fully investigated by Filhol. This able palæontologist regards it as most nearly allied to the genus Galago now existing in Africa. It furnishes conclusive evidence of the former existence of lemurs in France.

[1] See NATURALIST, 1884, p. 353.

Of the three genera with very large incisor (? canine) teeth, Mixodectes has the last lower premolar with a simple cusp. There are two species from the Puerco beds. The smaller of these, *M. pungens* Cope (Fig. 9), is about the size of the kit fox. Its premolars are of irregular size. In the two other genera the fourth premolar has a second cusp on the interior side of the principal one. Both have the crowns of the inferior true molars composed of two triangles as in Mixodectes and Pelycodus. In Microsyops Leidy, there is but one one-rooted premolar. There are three species from the Wasatch and Bridger beds. The type is the *M. gracilis* Marsh (Fig. 2*b*), from the latter. It was a small animal, not exceeding a gray squirrel in dimensions. In Cynodontomys the premolar teeth are more reduced in size than in any of the allied genera, two of the three being one-rooted. The large ? incisor tooth has a correspondingly large development. The species was found by Mr. Wortman in the Wasatch beds of the Big Horn basin, Wyoming Terr.

FIG. 9.—*Mixodectes pungens* Cope, lower jaw right ramus, natural size. Fig. *a'*, from above. Original, from Vol. III Report U. S. Geolog. Survey Terrs.

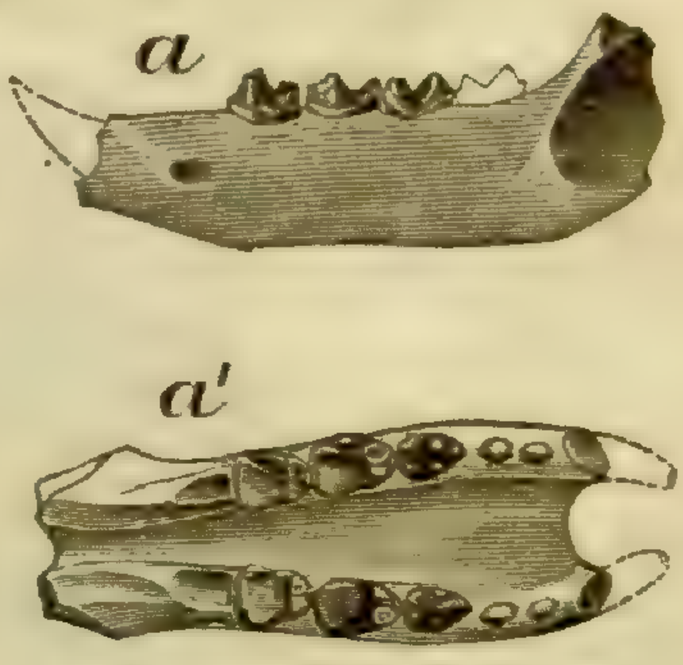

FIG. 10.—*Cynodontomys latidens* Cope, mandible, nat. size, from Wasatch beds of Wyoming. Fig. *a'*, from above. Original, from Report U. S. Geol. Surv. Terrs., Vol. III, F. V. Hayden in charge.

The most evident lemuroids yet found in America belong to the family of the Anaptomorphidæ. But one genus is certainly known to belong to it, Anaptomorphus Cope. The genus Indrodon[1] resembles it in dental formula excepting in the possession of three instead of two incisors. It embraces but one species, *I. malaris*, which was found by David Baldwin in the Puerco formation of New Mexico.

Anaptomorphus was founded on the lower jaw of a small species, *A. æmulus* Cope, which does not exceed that of a ground squirrel (Tamias) in size (Fig. 11). It agrees with a very few of the living lemurs (Indrisinæ) in the number of its teeth, but it differs from them all in having short erect incisor teeth as in the higher monkeys. The molar teeth known are a good deal like those of

[1] Proceedings American Philosophical Society, 1883, p. 318.

the true monkeys in character, being quadrituberculate. The last premolar is quite different, having a compressed, simple, cutting crown. The canine is quite small, and there is no diastema. The evidence furnished by this jaw was happily supplemented by the discovery, at a later day, of an almost entire cranium of a closely allied species in the Wasatch beds of Wyoming by Mr. J. L. Wortman. The species it indicated is rather larger than the *A. æmulus*, and I gave it the name of *A. homunculus* (Fig. 12).

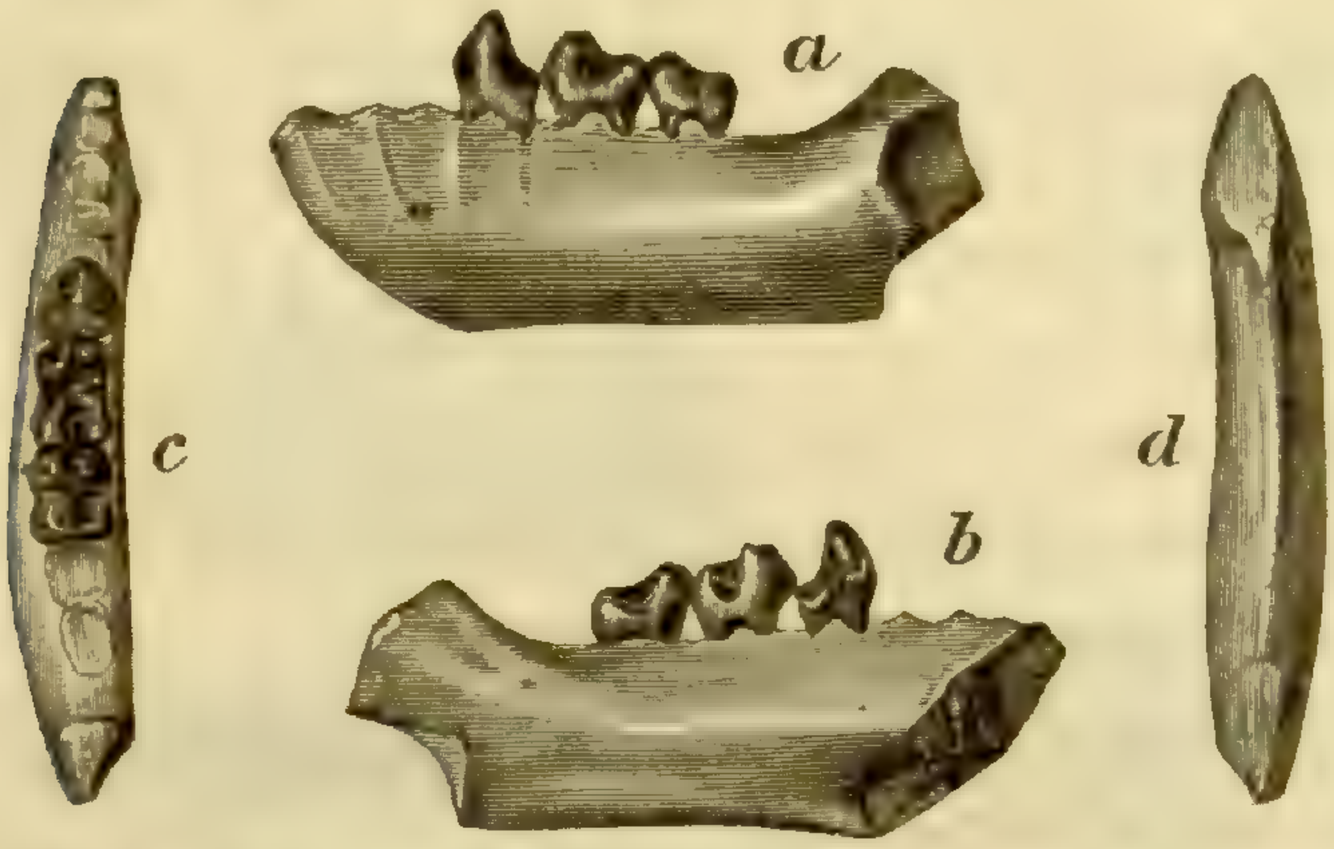

FIG. 11.—*Anaptomorphus æmulus* Cope, left ramus of mandible, twice natural size, linear; *b*, inner side; *c*, from above; *d*, from below. From Bridger bed of Wyoming. Original.

The characters of this genus now known warrant us in thinking it one of the most interesting of Eocene Mammalia. Two special characters confirm the reference to the Lemuroidea which its

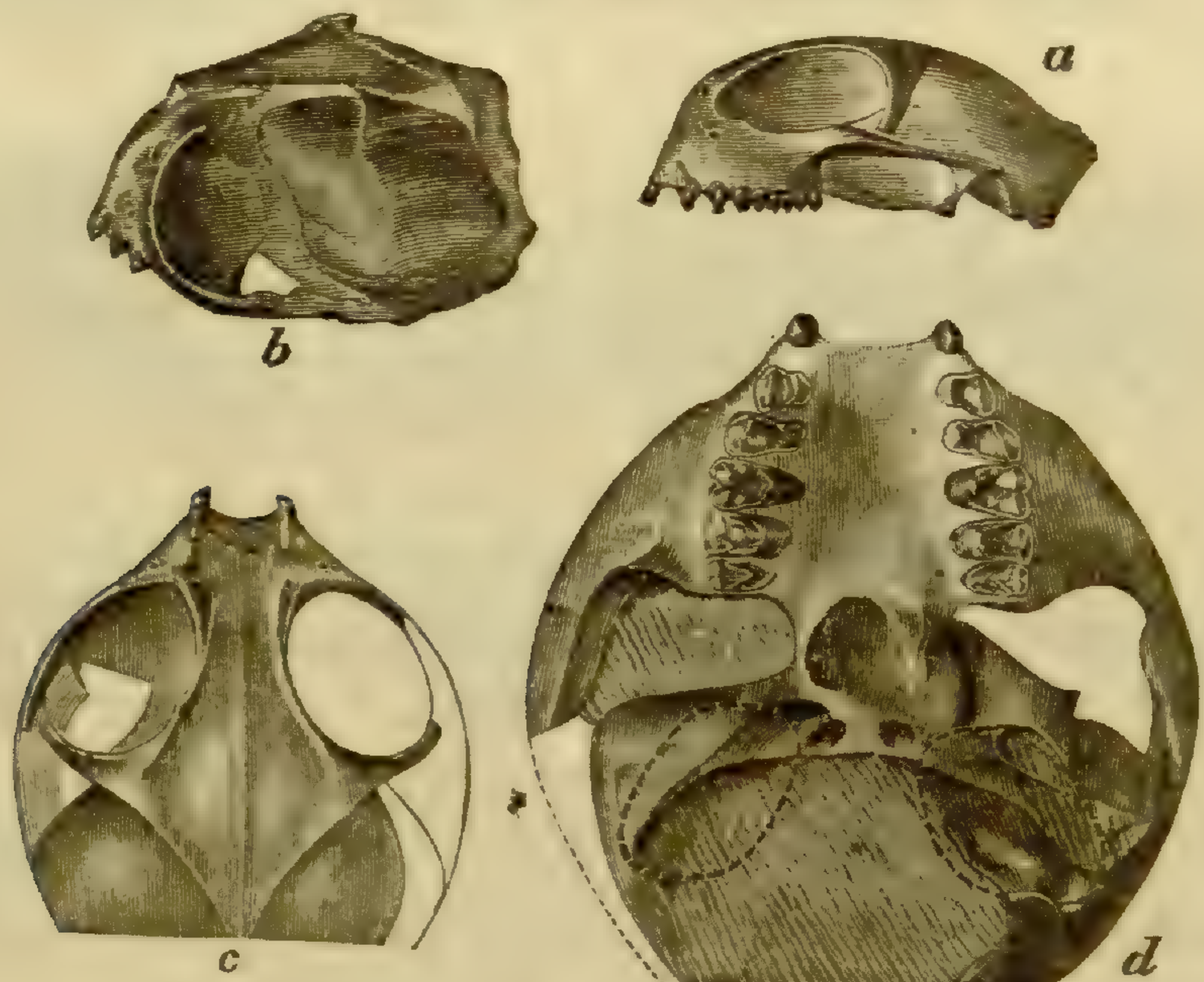

FIG. 12.—*Anaptomorphus homunculus*, skull, natural size except Fig. *d* which is one-half larger than nature, from the Wasatch beds of the Big Horn, Wyoming. Fig. *a*, right side of skull; *b*, oblique view of same showing outline of cerebral hemisphere, postorbital arch removed; *c*, same from above; *d*, the same from below, enlarged one-half, the dotted lines indicate the form of the otic bullæ. Original, from Report U. S. Geol. Survey Terrs.. III, F. V. Hayden in charge.

physiognomy suggests. These are the external position of the

lachrymal foramen and the unossified symphysis mandibuli. Among Lemuridæ its dental formula agrees only with the Indrisinæ, which have, like Anaptomorphus, two premolars in each jaw. But no known Lemuridæ possess interior lobes and cusps of all the premolars, so that in this respect, as in the number of its teeth, this genus resembles the higher monkeys, the Simiidæ and Hominidæ more than any existing member of the family. Of these two groups the resemblance is to the Hominidæ in the small size of the canine teeth. It has, however, a number of resemblances to Tarsius, which is perhaps its nearest ally among the lemurs, although that genus has three premolars. One of these points is the anterior extension of the otic bullæ, which is extensively overrun by the external pterygoid ala. A consequence of this arrangement is the external position of the foramen ovale, just as is seen in Tarsius. Another point is the probably inferior position of the foramen ovale. Though this part is broken away in the cranium of *Anaptomorphus homunculus*, the paroccipital process is preserved, and has the position seen in Tarsius, as distinguished from the Indrisinæ, Lemuridæ, Galaginæ, etc. In this it also resembles the true Quadrumana.

When we remember that the lower Quadrumana, the Hapalidæ and the Cebidæ, have three premolar teeth, the resemblance of Anaptomorphus to the higher members of that order is more evident. The brain and its hemispheres are not at all smaller than those of the Tarsius, or of the typical lemurs of the present period. This is important in view of the very small brains of the flesh-eating and ungulate Mammalia of the Eocene period so far as yet known. In conclusion, there is no doubt but that the genus Anaptomorphus is the most simian lemur yet discovered, and probably represents the family from which the anthropoid monkeys and men were derived. Its discovery is an important addition to our knowledge of the phylogeny of man.

The *Anaptomorphus homunculus* was nocturnal in its habits, and its food was probably like that of the smaller lemurs of Madagascar and the Malaysian islands. Its large orbits and large otic bullæ indicate great acuteness of the senses of sight and hearing. Its size is a little less than that of the *Tarsius spectrum*.

In Pelycodus we have a more decidedly insectivorous type of dentition in the lower jaw, although that of the upper jaw (Fig. 1) has a lemurine character. Enough of the poste-

rior foot is known to show that its structure is like that of Condylarthra, lemurs and the majority of the Insectivora (Figs. 14, 15, 16). The quadrituberculate superior molars (Fig. 1) forbid the reference of the genus to the Creodonta, and if all the ungues are like that represented in Figs. 11 *d*, it cannot be placed in either the Lemuroidea or Condylarthra, but is an insectivore more or less allied to the East Indian Tupæa. The ankle joint (Fig. 14) is flat, or without trochlea. The head of the astragalus is simple and convex, and is prolonged beyond the calcaneum, giving space for a rather long cuboideum. The lower end of the fibula is large (Fig. 15 *b*) and is extensively applied to the astragalus.

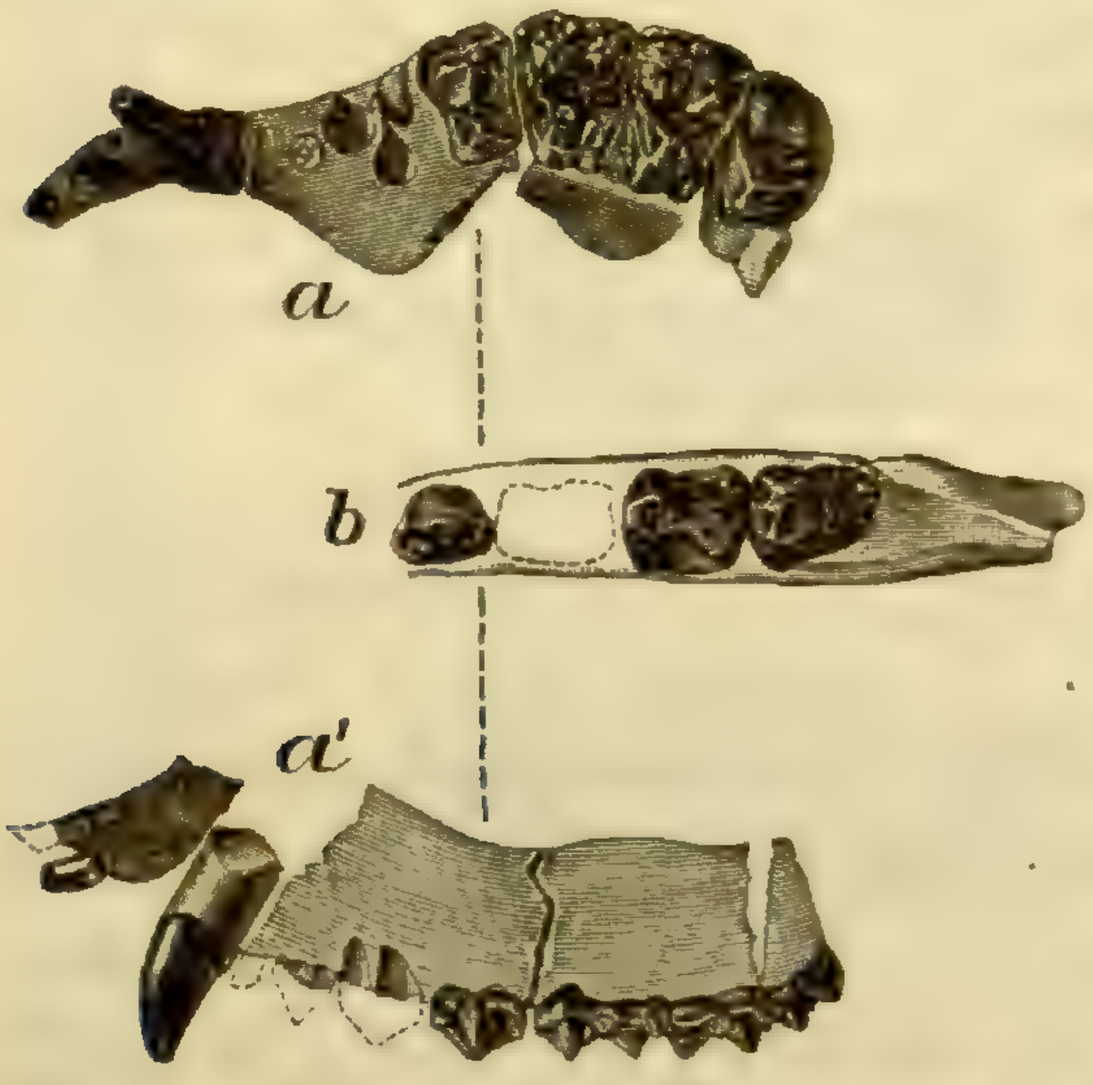

FIG. 13.—*Pelycodus tutus* Cope, portions of skull, from the Wasatch epoch of Wyoming, natural size. Fig. *a*, superior dentition from below; *a'*, the same, external view; *b*, inferior molars 4–6 and 7, from above. Original from Report U. S. Geol. Survey Terrs., III.

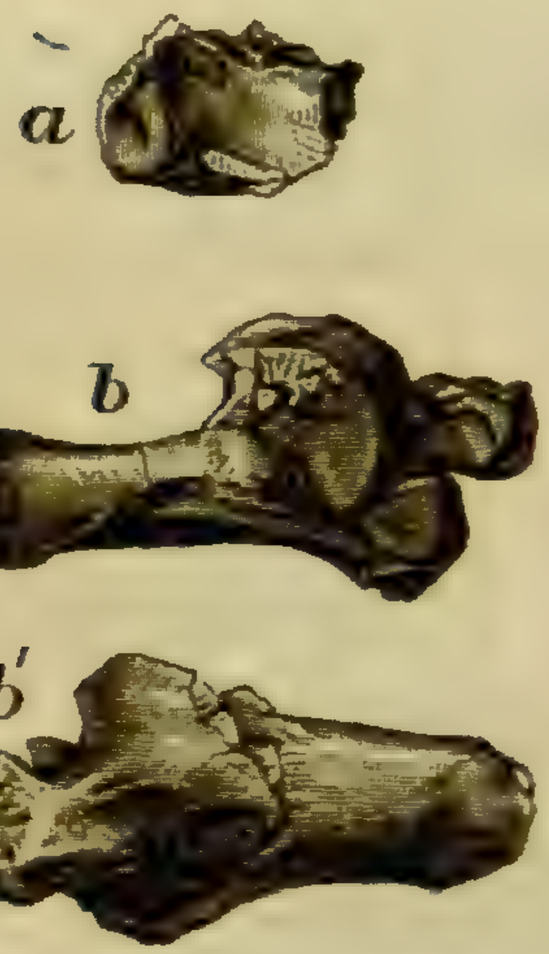

Fig. 14.

Fig. 15.

FIG. 14.—*Pelycodus jarrovii* Cope, ankle joint, nat. size. Fig. *a*, distal extremity of tibia; *b*, astragalus and calcaneum, external view; *b'*, do., internal superior view. From Wasatch bed New Mexico. Original, from Report U. S. Geol. Survey W. of 100th meridian.

FIG. 15.—*Pelycodus jarrovii* Cope, individual represented in Fig. 14, nat. size. Fig. *a*, head of radius; *b*, distal end of fibula; *c*, patella; *d*, entocuneïform, outer side, *d'*, inner side, *d''*, distal end. Original, from Report U. S. Geol. Survey W. of 100th mer., G. M. Wheeler.

The entocuneïform bone (Fig. 15 *d*) shows clearly that the hallux

was not opposable, a character which adds weight to those already mentioned which indicate that the true place of this genus is in the insectivorous order. The large patella (Fig. 15 *c*) shows that the genus is not marsupial. The head of the radius (Fig. 15 *a*) is an oval, agreeing in this with the orders mentioned, excepting the Lemuroidea, and showing that the supination of the manus could be only imperfectly or not at all performed.

But three species of Pelycodus are known, and these are confined to the Wasatch bed of New Mexico and Wyoming. Two species formerly referred here have been separated under the name Chriacus and placed in the Leptictidæ of the Creodont suborder.[1]

The family of the Arctocyonidæ includes more or less carnivorous animals with quadrituberculate true molars above. The known genera, of which there are four, possess large canine teeth and quadrituberculate inferior molars. The bones of Arctocyon have been described by Lemoine, so far as known, and they are like those of Creodonta, having a flat astragalus and an epicondylar foramen of the humerus. Their quadritubercular superior molars place them in the Insectivora as I have defined that suborder.[2] *Arctocyon primævus* Blv., is a celebrated fossil of the Suessonian beds of France. The single species of Hyodectes and Heteroborus are each from the Puerco beds of France. In America the family is represented by the genus Achænodon Cope, of which three species are known according to Osborn. The dentition is somewhat suilline in character, and Mr. Osborn has accordingly referred the genus to the suilline Artiodactyla. As none of the bones of the skeleton are known, the question remains unsettled. The anterior crest of the glenoid cavity grasps the condyle of the lower jaw as in a carnivorous animal,

FIG. 16.— *Pelycodus tutus* Cope, bones of digit found loose but together. Fig. *a*. metapodial; *b*, first, *c*, second, and *d*, ungual phalanges; *d'*. side, and *d''*, proximal end, nat. size. From Wasatch bed of New Mexico.

[1] See NATURALIST, 1884, pp. 348–352.

[2] Report U. S. Geol. Survey Terrs., III, p. 739.

but the character is also found in the peccary. The typical species, *A. insolens* Cope (Fig. 17), is as large as the largest bears. The *A. robustus* Osborn, is about the same size. A large part of the skull has been discovered. This displays a very high sagittal

FIG. 17.—*Achænodon insolens* Cope, lower jaw, three-eighths nat. size, from above, and right ramus from inner side. From Bridger epoch of Wyoming. Original, from Vol. III Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

crest and a very small space for a brain. Its brain was probably of a low type, as has been shown to be the case in Arctocyon by Gervais. In that genus the hemispheres are smooth and very small, leaving the olfactory lobes and cerebellum entirely un-

covered. The resemblance to the brain of the opossum is well

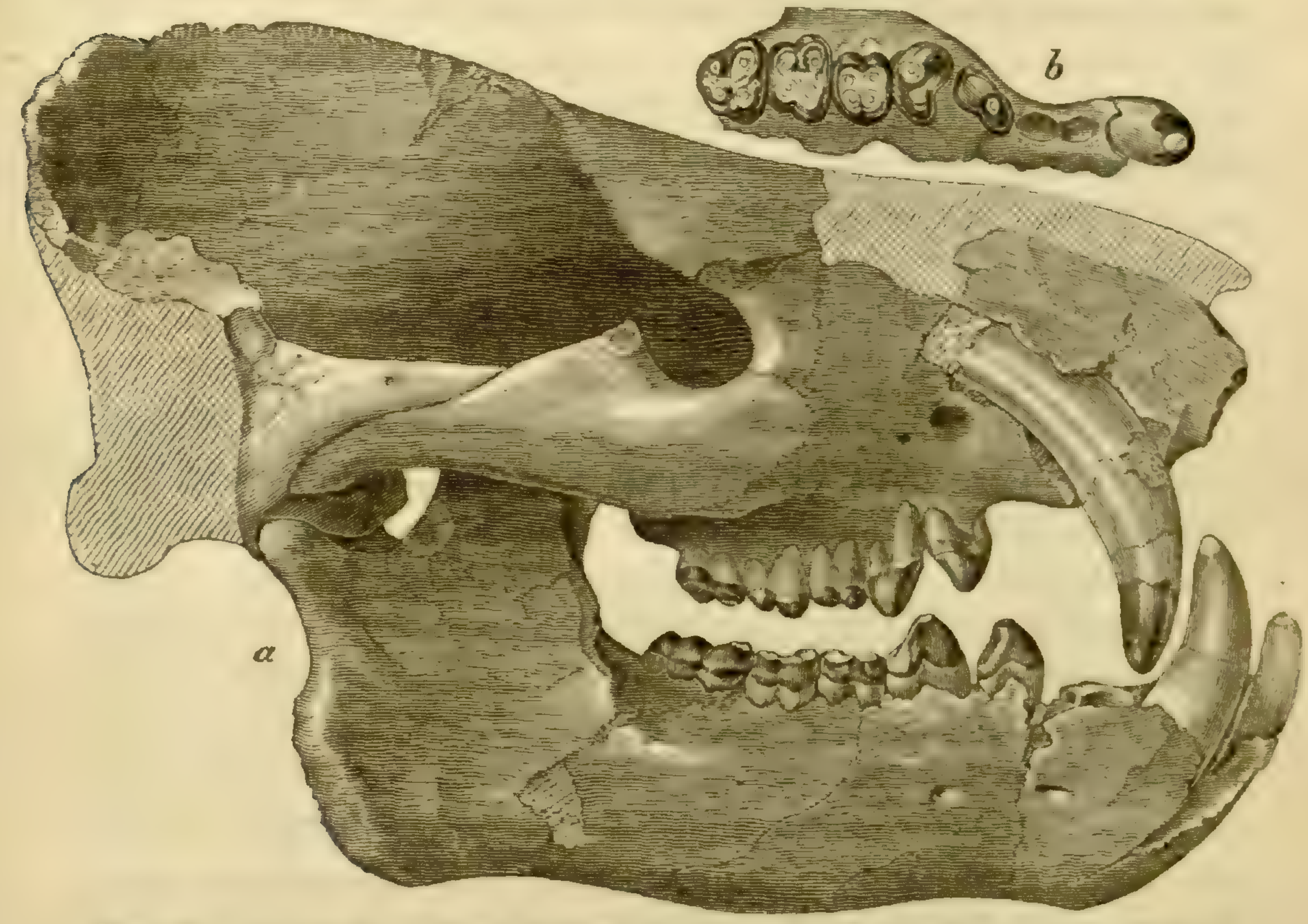

FIG. 18.—*Achænodon robustus* Osborn, skull one-fourth nat. size, from the Bridger bed of the Washakie basin, Wyoming. Fig. *b*, maxillary bone with teeth from below. From Osborn, Bulletin No. 3, E. M. Mus. Princeton College.

marked. In *Achænodon robustus* the orbit is small, indicating comparatively imperfect powers of vision (Fig. 18).

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NOTES ON THE LABRADOR ESKIMO AND THEIR FORMER RANGE SOUTHWARD.

BY A. S. PACKARD.

IT is not my purpose to give an account of the Labrador Eskimo, but simply to put together what I have found in relation to them in works referring to Labrador, and to add a few notes made during two summers spent on that coast in 1860 and 1864. Although I was aware that the Eskimo formerly lived as far south as the southern entrance to the Straits of Belle Isle, where I saw two individuals in 1860, one said to be a full-blooded Eskimo woman, I regarded them as stragglers from the north. It now seems more probable, from the Rev. Mr. Carpenter's statement, to be hereafter given, and from the fact, to be hereafter stated, that several hundred Eskimos lived at

Chateau bay, opposite Belle Isle, in 1765, while others were known to have extended as far east as the Mingan islands, that this race had a more or less permanent foothold on the northern shores of the Gulf of St. Lawrence. If this was so, it seems not improbable but that this roving race may have made, in very early times, expeditions farther south to Nova Scotia and New England. Here also comes to mind the theory of Dr. C. C. Abbot, that the Eskimo formerly inhabited the coast of New Jersey during the river terrace epoch.

Although at first disposed to reject such an assumption, the examination we have made leads us to look with more favor upon Dr. Abbot's theory, and to think it not improbable that long after the close of the glacial period, *i. e.*, after the ice had disappeared and during the terrace epoch, when the reindeer and walrus lived as far south as New Jersey, that the Eskimo, now considered so primitive a race, perhaps the remnants of the Palæolithic people of Europe, formerly extended as far as a region defined by the edge of the great moraine; and as the climate assumed its present features, moved northward. They were also possibly pushed northwards by the Indians, who may have exterminated them from the coast south of the mouth of the St. Lawrence, the race becoming acclimated to the arctic regions. All these hypotheses came up afresh in our mind last summer when we began to collect these notes. Their substantiality became more pronounced after reading the confirmatory remarks made by Professor E. B. Tylor at the Montreal meeting of the British Association. We are not now, however, prepared to adopt the view that the Norsemen did not go as far south as Narragansett bay, and that the natives they saw were not red Indians, their word "skralings" being indiscriminately applied to any of the native tribes they saw. Two voyages from Labrador to New England, not far possibly from the route taken by the Norsemen, lead us to think that their vessels, with fair winds, actually did sail a thousand miles to Cape Cod from Southern Labrador or Newfoundland in nine or ten days. We have made the trip from Cape Cod to the Gut of Canso in about two days, the time given in the Norsemen sagas; but we do not intend at this time to touch upon this attractive subject.

We do find, however, unexpected confirmation of Professor Tylor's supposition that "Eskimos eight hundred years ago, be-

fore they had ever found their way to Greenland, were hunting seals on the coast of Newfoundland, and caribou in the forest," for these events did actually happen in Newfoundland, or at least there are traces of Eskimo residence in large numbers at Chateau bay in 1765, of their repeated crossing over to Newfoundland, and of their learning a few French words from the French settlers.

At all events the facts we here present should induce our New England and Canadian archæologists to make the most careful examination of the shell-heaps about the mouth of the St. Lawrence, and on the shores of Northern and Southern Nova Scotia, as well as Maine and Northern Massachusetts for traces of Eskimo occupation.

Facts seem to confirm the early belief of the Greenland Danish and Moravians that the Labrador Eskimo were an older people than those who migrated into Greenland. In the extracts from the appendix to Cranch's History of Greenland given farther on, we shall see that the Eskimo of these two regions differed in their dress and kayaks, differences we have personally noticed.

Whether the Labrador Eskimo are an older stock than those living directly north of Hudson's bay we cannot say. Crantz, however, remarks: "As early then as the year 1800 our missionaries learned from the reports of Northlanders, who visited their settlements, that the main seat of the nation was on the coast and islands of the north, beyond *Cape Chudleigh*." Crantz, in a note, (XVI) also claims: "There can be no hesitation in affirming that Greenland was peopled from Labrador, not Labrador from Green land."

The theory that the Eskimo entered America by way of Bering strait, now generally received, was thus stated by Crantz in 1767: "Our Greenlanders it should seem having settled in Tartary after the grand dispersion of the nations, were gradually impelled northward by the tide of emigration, till they reached the extreme corner of Kamtschatka, and finding themselves disturbed even in these remote seats, they crossed the strait to the neighboring continent of America. * * * Our savages then retired before their pursuers across the narrow strait, either by a direct navigation, or by a more gradual passage from island to island, to America, where they could spread themselves without opposition through the unoccupied wastes round the south-east part of Hudson's bay, or through Canada up to the northern ocean. And

here they were first met with in the eleventh century by the discoverers of Wineland. But when they were compelled to evacuate these possessions likewise, by the numerous tribes of Indians superior to themselves in strength and valor, who thronged to the north out of Florida, they receded nearer to the pole, as far as the 60th deg. Here Ellis in his voyage to Hudson's bay found the Esquimaux,[1] resembling the Greenlanders in every particular of dress, figure, boats, weapons, houses, manners and customs. * * * The clerk of the *California*[2] says that these Esquimaux are grievously harassed by the Indians inhabiting the south and west shores of Hudson's bay, who are in all respects a distinct race. An unsuccessful hunting or fishing expedition is a sufficient pretext for their oppressors to fall upon them and take them prisoners or murder them. These acts of violence have induced the fugitives to retreat so far to the northward ; and part of them in all probability passed over to Greenland in the fourteenth century, either crossing Davis's strait in their boats from *Cape Walsingham*, in lat. 66° to the South bay, a distance of scarcely forty leagues, or otherwise proceeding by land round the extremity of Baffin's bay, where, if we may trust the reports of the Greenlanders, stone-crosses, like guide-posts, are still to be seen at intervals along the coast."

That the Eskimo were more abundant on the eastern shores of Hudson's bay may be proved by the following extracts from Coats' Notes on the geography of Hudson's bay, reprinted by the Hakluyt Society.[3] It appears from his notes that the Eskimo inhabited Labrador from the Gulf of St. Lawrence around to James bay, *i. e.*, as far south in Hudson's bay as Belcher's island (lat. 56° 06′) and the Sleepers. Their southern range was probably Hazard gulf, in lat. 56° 22′ ; the coast of Hudson's bay is wild and barren, with floating ice. Speaking of the barren, treeless coast from Cape Diggs to Hazard gulf, Coats says: "Doubtless the native Usquemows know the time and seasons of those haunts, and nick it, for we found vestiges of them

[1] Charlevois derives this name from the Indian word *Eskimantsik*, which in the language of the Abenaquis signifies *to eat raw ;* and it is certain that they eat raw fish.

[2] Account of a voyage for the discovery of a north-west passage, Vol. II, p. 43.

[3] Notes on the Geography of Hudson's bay, being the remarks of Capt. W. Coats in many voyages to that locality between the years 1727 and 1751. Edited by John Barrow. London, Hakluyt Society, 1852. 8vo.

at all the places we stopt att." From the foregoing extract it is obvious that Capt. Coats obtained his knowledge of the Labrador Indians and the Eskimo from his personal observations and inquiries while in Hudson's bay; he personally only by hearsay received information that the Eskimo, by whalers called "Huskies," lived as far south as St. Lawrence bay; but his statement will be seen to be confirmed by Crantz. The northern Indians mentioned by Coats are undoubtedly the Naskopies.

The following extracts from the appendix to Crantz' History of Greenland, English translation, fully prove that several hundred Eskimo spent the summer at Chateau bay opposite the north-eastern extremity of Newfoundland, and also crossed over to the latter island, and must have been, for several years at least, residents on the shores of the Strait of Belle Isle. The first visit of the Moravians to the Labrador coast was in 1752; Christian Erhard, a Dutchman, but a member of the Moravian society, landed, in July in Nisbet's haven, with a boat's crew of five men at a point north of this harbor; where all were murdered by the Eskimo, the vessel returning to England. The next attempt to approach the Eskimo was made in 1764, by Jens Haven, who had labored for several years as a missionary in Greenland, and had recently returned with Crantz to Germany. With letters of introduction to Hugh Palliser, Esq., the governor of Newfoundland, in May of the same year he arrived at St. Johns; "but he had to meet with many vexatious delays before he reached his destination, every ship with which he engaged refusing to land for fear of the Esquimaux. He was at length set on shore in Chateau bay, on the southern coast of Labrador; here, however, he found no signs of population except several scattered tumuli, with the arrows and implements of the dead deposited near them. Embarking again he finally landed on the Island of Quirpont or Quiveron, off the north-east extremity of Newfoundland, in the Strait of Belle Isle, where he had the first interview with the natives. "The 4th September," he writes in his journal, "was the happy day when I saw an Esquimaux arrive in the harbor. I ran to meet him and addressed him in Greenlandic. He was astonished to hear his own language from the mouth of an European, and answered me in broken French." The next day eighteen returned his visit. On the third day the Eskimo left the harbor altogether, and after a short stay at Quirpont, Haven returned to Newfoundland.

The following year Haven, with three other missionaries, landed, July 17, 1765, in Chateau bay, lat. 52°, on the south shore of Labrador, opposite Belle Isle. "Here the party separated; Haven and Schlötzer engaging with another vessel, to explore the coast northwards; they did not, however, accomplish anything material in this expedition, nor did they meet with a single Esquimaux the whole time. Drachart and John Hill remained in Chateau bay, and were fortunate enough to have the company of several hundred Esquimaux, for upwards of a month; during which period they had daily opportunities of intercourse. As soon as Sir Thomas Adams had received intelligence that they had pitched their tents at a place twenty miles distant, he sailed thither to invite them, in the name of the governor, to Pitts harbor. On the approach of the ship the savages in the kajaks hailed them with shouts of Tout camarade, oui Hu! and the crew returned the same salutation. Mr. Drachart did not choose to join in the cry, but told Sir Thomas that he could converse with the natives in their own language. When the tumult had subsided he took one of them by the hand and said in Greenlandic "We are friends." The savage replied, "We are also thy friends."

Crantz then describes from the notes of Haven and Drachart, the peninsula of Labrador and some of the animals as well as the habits of the Eskimos. These people remained at Chateau bay through the summer until at least after the middle of September, as on Sept. 12th and 13th the shallop ran ashore, and the Eskimo invited them to lodge in their tents, carrying the missionaries ashore on their backs.

The following extract shows that the Eskimo must, before the year 1765, have been in the habit of crossing the Straits of Belle Isle and landing on Newfoundland:

"The governor wished to prevent them from crossing over to Newfoundland, where, according to their own account, they procured a certain kind of wood not to be found in their country, of which they made their darts. But since they interpreted this prohibition as a breach of peace, it was rescinded, on their promise to commit no depredation on the fishing vessels they might meet with on the way; to which engagement they scrupulously adhered."

The account then goes on to say that during the interval which occurred between the visit of Haven and Drachart in 1765 and

the foundation of the first missionary settlement at Nain in 1771, "the old quarrels between the natives and the English traders were resumed; and as no one was present who could act as interpreter and explain the mutual grounds of difference, the affair terminated in bloodshed. Nearly twenty of the natives were killed in the fray, among whom was Karpik's father; he himself, with another boy and seven females, were taken prisoners and carried to Newfoundland. One of these women, of the name of Mikak, and her son, were brought to England, where they recognized an acquaintance in Mr. Haven, who had formerly slept a night in their tent. Karpik was detained by Governor Palliser, with the intention of committing him to the care of Mr. Haven, to be trained up for usefulness in a future mission to his countrymen. He did not arrive in England till 1769, at which time he was about fifteen years old." He died in England of small-pox.

We glean a few more items from Crantz regarding the distribution, numbers, and habits of the Labrador Eskimos. The Moravians, after founding Nain (lat. 56° 25′), determined to found two other stations, one to the north and the other to the south. Okkak (150 miles north of Nain in lat. 57° 33′) was thus founded on land purchased from the Eskimo in 1775, Haven with his family establishing himself there the following year. The reason for founding these stations was for the reason that it "was found insufficient to serve as a gathering place for the Eskimo dispersed along a line of coast not less than six hundred miles in extent, especially as it afforded but scanty resources to the natives during the winter season, when they had fewer inducements to rove from place to place."

In the summer of 1782 the Moravians began a third settlement to the south, "on the spot which they had formerly marked out and purchased from the Esquimaux. This station received the name of Hopedale." As obstacles to the missionary work were the following: "The spirit of traffic had become extremely prevalent amongst the Southern Esquimaux, the hope of exaggerated advantages which they might derive from a voyage to the European factories, wholly abstracted their thoughts from religious enquiries; and one boat-load followed another throughout the summer. A Frenchman from Canada, named Makko, who had newly settled in the south, and who sustained the double character of trader and Catholic priest, was particularly successful in

enticing the Esquimaux by the most tempting offers. Besides the evil consequences resulting from these expeditions in a spiritual point of view, so large a proportion of their wares was thus conveyed to the south that the annual vessel which brought out provisions and other necessaries for the brethren, and articles of barter for the natives, could make up but a small cargo in return, though the brethren, unwilling as they were to supply this ferocious race with instruments which might facilitate the execution of their revengeful projects, furnished them with the firearms, which they could otherwise, and on any terms, have procured from the south."

Crantz then mentions a feature of Eskimo life, which however repugnant to the feelings of the Moravians, is of interest to the ethnologist, and has not, so far as we are aware, been observed among the Eskimo of late years. This is the erection of a temporary winter éstufá or public game-house. "A *kache*, or pleasure-house, which, to the grief of the missionaries, was erected in 1777, by the savages near Nain, and resorted to by visitors from Okkak, has been described by the brethren. It was built entirely of snow, sixteen feet high and seventy feet square. The entrance was by a round porch, which communicated with the main body of the house by a long avenue terminated at the farther end by a heart-shaped aperture, about eighteen inches broad and two feet in height. For greater solidity the wall near the entrance was congealed into ice by water poured upon it. Near the entry was a pillar of ice supporting the lamp, and additional light was let in through a transparent plate of ice in the side of the building. A string hung from the middle of the roof, by which a small bone was suspended, with four holes driven through it. Round this all the women were collected, behind whom stood the men and boys, each having a long stick shod with iron. The string was now set a-swinging, and the men, all together, thrust their sticks over the heads of their wives at the bone, till one of them succeeded in striking a hole. A loud acclamation ensued; the men sat down on a snow seat, and the victor, after going two or three times round the house singing, was kissed by all the men and boys; he then suddenly made his exit through the avenue, and, on his return, the game was renewed."

The narrative then goes on to state that "one of the objects of the establishment at Hopedale had been to promote an inter-

course with the red Indians who lived in the interior, and sometimes approached in small parties to the coast. A mutual reserve subsisted between them and the Esquimaux, and the latter fled in the greatest trepidation when they discovered any traces of them in their neighborhood. In 1790, however, much of this coldness was removed, when several families of these Indians came to Kippokak, an European factory about twenty miles distant from Hopedale. In April, 1799, the missionaries conversed with two of them, a father and son, who came to Hopedale to buy tobacco. It appeared that they were attached to the service of some Canadians in the southern settlements, as well as many others of their tribe, and had been baptized by the French priests. They evidently regarded the Esquimaux with alarm, though they endeavored to conceal their suspicions, excusing themselves from lodging in their tent on account of their uncleanly habits. At parting they assured the brethren that they would receive frequent visits from their countrymen, but this has not as yet been the case."

From Cartwright's "Journal of a Residence in Labrador" we glean the following statements, which certainly confirm those of the Moravians: In 1765 a blockhouse was erected in a small fort at Chateau bay to protect the English merchants from the Eskimo. (Cartwright also gives the best account we have seen of the Bethuks of Newfoundland.) The southern tribe of Eskimo were at Chateau bay in 1770, Cartwright observing that some Moravians were there at the same time. He also states that there was an Eskimo settlement "some distance to the northward" of Cape Charles, and that a family of nine Eskimo came to spend the winter living near Cartwright's house, and more Eskimo came to join them in July, 1771, there being thirty-two in all; they traded whalebone with the Eskimo to the northward. Cartwright saw deserted Eskimo winter houses near Denbigh island.

In 1771 he saw an Eskimo pursuing a "penguin" in his kayak near Fogo island, off the coast of Newfoundland!

August 30, 1772, "500 or thereabouts" Eskimo arrived at Charles' harbor from Chateau bay to the southward, to meet their relations from London, whom Cartwright had the year previous taken with him to London, some of them having died in England of the small-pox. In April and May, 1776, Eskimo were observed living near Huntington island. Many Eskimo died in Ivuktoke inlet, probably from the small-pox, brought over from

England. Cartwright also reports seeing Eskimo at Huntington island in 1783, also at Chateau bay, where they were observed in 1786.

The foregoing extracts abundantly prove that the Eskimo repeatedly crossed to Newfoundland, residing, during the summer at least, on the outer islands opposite Belle Isle. No reference is made to the former presence of the Eskimo in Newfoundland. It is not improbable that there was at least a slight intercourse between the Bethuks, the aborigines of Newfoundland, said to be a branch of the Algonkins, and found to be in possession of the island by Cabot in 1497. A stone vessel dug up with other Bethuk remains, is "an oblong vessel of soft magnesian stone, hollowed to the depth of two inches, the lower edges forming a square of three and a half inches in the sides. In one corner is a hollow groove, which apparently served as a spout."[1] If this is, as has been suggested to us by Professor Tylor, attributable to the influence of Eskimo art, the style may have been suggested by the possible intercourse of these aborigines with the wandering Eskimo.

In connection with the subject of the relations between the Indians of Newfoundland and the Labrador Eskimo, may be cited the following statement of that industrious historian, the late Jesuit, Father Vetromile. In an article entitled "Acadia and its Aborigines,"[2] he says: "The Etchimins, Micmacs and Abenakis are very often considered as one nation, not only on account of the similarity of their language, customs, suavity of manners and attachment to the French, but also for their league in defending themselves against the English. Although the Micmacs are generally somewhat smaller in size than the other Indians of Acadia and New France, yet they are equally brave. They have made a long war against the Esquimaux (eaters of raw flesh), whom they have followed and attacked in their caverns and rocks of Labrador. Newfoundland must have several times been the field of hard wars between the Micmacs and Esquimaux; the latter were always chased by the former" (p. 339).

Whether these statements are well grounded, we cannot say,

[1] Newfoundland, its history, its present condition, and its prospects in the future. By Joseph Hatton and the Rev. M. Harvey, Boston, 1883, p. 169. See also Mr. Lloyd's paper, Journal of the Anthropological Institute of Great Britain and Ireland.

[2] Collections of the Maine Hist. Soc., VII, pp. 339–349. 1876. Communicated Jan. 16, 1862.

and have been unable thus far to obtain the sources from which the author drew his conclusions that there were contests between the Eskimo and Indians on Newfoundland soil. Nearly all the extracts we have made tends to show that the Eskimo were generally driven northward by the Indians and confined by them to their natural habitat, the treeless regions of Arctic America, whither the Indians themselves did not care to penetrate.

In 1811 two Moravian missionaries[1] explored the northern coast of Labrador from Okkak to Ungava bay, making an excellent map of this part of the coast. The expedition arose from their desire to establish missions where the Eskimo were abundant, as farther down the coast they were regarded as "mere stragglers."

An Eskimo tradition of interest is mentioned in this book, as follows: "July 24th. Amitok lies N. W. from Kummaktorvik, is of an oblong shape, and stretches out pretty far towards the sea. The hills are of moderate height, the land is in many places flat, but in general destitute of grass. On the other side are some ruins of Greenland [Eskimo] houses.

"The Esquimaux have a tradition that the Greenlanders [*i. e.*, Greenland Eskimo] came originally from Canada, and settled on the outermost islands of this coast, but never penetrated into the country before they were driven eastward to Greenland. This report gains some credit from the state in which the above-mentioned ruins are found. They consist in remains of walls and a grave, with a low stone enclosure round the tomb, covered with a slab of the same material. They have been discovered on islands near Nain, and though sparingly, all along the whole eastern coast, but we saw none in Ungava bay."

(*To be continued.*)

[1] Journal of a voyage from Okkak, on the coast of Labrador, to Ungava bay, westward of Cape Chudleigh, undertaken to explore the coast and visit the Esquimaux in that unknown region. By Benj. Kohlmeister and George Knoch, missionaries of the Church of the Unitas Fratrum. London, 1814, 8vo, pp. 83.

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— Naturalists will be the gainers by the present discussion of the question as to the existence of objects of more or less than three dimensions. We are accustomed to regard mathematics as exact, and in its true function as the science of *relations* it is so. But we have not always remembered that it may treat of the relations of imaginary quantities as readily as those of real ones. Hence it need not surprise us if the mathematical mind sometimes concerns itself but little with the question of the reality of the subjects of its discussions. This is the explanation of the extraordinary mental phenomenon displayed at the present time in the attempt, by some men of much acuteness, to persuade themselves and others of the existence of objects of two and four dimensions. The argument rests on the *very transparent* assumption that because we usually see only the surface of things, *i. e.*, two dimensions, such surface has an existence apart from the three-dimensional body of which it is an aspect. The deduction then follows that if from the perception of two dimensions we can rise by mental process to a perception of three dimensions, why is it not possible that some minds can rise from the third dimension to a perception of a fourth. The naturalist, however, will expect a third dimension before he will permit himself to believe that he has an object, and any one who would do otherwise would soon find himself in the limbo of the damnati. We invite our two and four-dimensional friends to give us a systema naturæ. Let them have their Linnæus, Cuvier and Darwin. We fear, however, that two-dimensional objects placed edgwise to the line of vision would be overlooked by these gentlemen, while for four-dimensional beings a new teratology would have to be written.

—— Professor John Collett has been removed from the position of State geologist of Indiana, and Professor J. Maurice Thompson has been appointed in his place by the legislature of Indiana. This change is from purely political motives, as nothing was alleged against Professor Collett unfavorable to his administration. We regret this change without knowing aught against the new appointee, as we regret all changes in scientific official relations without due cause. And when the incumbent is an accomplished geologist who has done much good work, and

the new officer is entirely unknown in science, the cause for regret is the greater.

—— The bestiarians are getting into trouble through their misrepresentations and libels. We learn from the *Journal of Science* that one Ernst Weber, in Germany, has been imprisoned for six months for making false assertions respecting the physiological investigations of Dr. Pelz. Professor H. N. Martin, of Johns Hopkins University of Baltimore, publishes a vigorous contradiction of the assertions of some British bestiarians, and protests against their statements as libelous. In Philadelphia Dr. Wister, addressing the Women's Society for the suppression of Physiology, calls vivisection "a crime." On the other hand Dr. W. W. Keen made vivisection the subject of his valedictory before the graduating class of the Women's Medical College. He demonstrated the importance of this branch of physiological research.

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RECENT LITERATURE.

RECENT PALÆONTOLOGICAL REPORTS OF THE SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.—It is now four years since the appearance of Mr. Lesquereux's two splendid volumes on the coal flora of Pennsylvania and the United States, with an atlas of eighty-seven plates. During the last year the third and last part of this great undertaking has appeared. Besides additions and corrections of the first and second volumes, there is a table of species referred to localities; a table of species referred to formations and a revised index of generic and specific names, referred both to pages and to plates, for all three volumes. The bulk of the third part is, however, devoted to descriptions of the new species obtained not only from Pennsylvania but from Arkansas, Rhode Island and other parts of the country. The number of new forms, many of them beautifully preserved and of great interest, fill twenty-six plates. Mr. Lesquereux remarks: "Like the vegetation of the present epoch, that of the Carboniferous has been modified and diversified by local circumstances, and is therefore differently represented at different localities if separated by a considerable distance. This can easily be seen in comparing the coal flora of Pennsylvania and Ohio with that of Illinois, Missouri, Kansas, etc. A certain degree of relation only is recognizable between the plants of strata of the same stage; but a large number of species are only locally found. The differences in the vegetation are still more marked according to stratigraphical distribution of the measures, or between the plants found in strata of different horizons; and as new coal-fields have been

recently opened and coal beds worked in Virginia, Tennessee, Alabama, Georgia, etc., at a lower stage than that of the Northern basins, a mass of specimens of fossil plants, not yet known in this country, have been discovered and sent from those localities." Mr. Lesquereux adds he has had to leave a large amount of specimens still unexamined, and he foresees "that there is left unknown, for future research and study of the history of the vegetation of the coal, an amount of materials at least as great and as important as that which has already been published."

Mr. Lesquereux acknowledges in a note the aid he has received in the loan of specimens from Mr. R. D. Lacoe, of Pittston, Pa., "who has directed for years explorations, still continued, in the more interesting localities of the coal-fields of North America. He has thus brought up, at great expense, a collection of fossil plants of divers formations, of insects, crustaceans, etc., which is not only by far the largest and most valuable of any in America, but which certainly may compare in this specialty with the richest collections of any of the European museums."

The other report is marked P.P.P., 1884, and contains two palæontological papers, valuable in themselves and for their illustrations. The first one, by Mr. C. E. Beecher on the Ceratiocaridæ of the Upper Devonian measures, we have already noticed in this journal; the second is a note by Professor James Hall on the Eurypteridæ from the lower coal measures, and it is illustrated by six heliotypes, an excellent way of illustrating these fossils. One new species (*Eurypterus potens*) is described, and the remains of other species fully illustrated.

THE ZOÖLOGICAL RECORD FOR 1883.[1]—That the work in systematic zoölogy throughout the scientific world went on in 1883 much as in former years, is proved by the fact that the size of each of these useful records remains about the same from year to year. The present volume, which contains no references to the Arachnida, is only twenty-eight pages shorter than its predecessor, in which that class occupied thirty-three pages.

The year 1883 was, so far as regards the mammals, chiefly marked by the large number of palæontological books and papers which appeared, among which those of Ameghino, Cope, Filhol, and Lydekker are the most prominent.

While there are no striking novelties in ornithological work, the year is reported to have been remarkable for a large amount of steady work. Little appears to have been done with the reptiles and Amphibia; beyond special papers no works on ichthology of general importance appeared this year.

As usual over half the volume is devoted to the Crustacea and especially the insects. Regarding the former several monographs

[1] *The Zoölogical Record for 1883;* being volume twentieth of the record of zoölogical literature. Edited by E. C. RYE. London, 1884, 8vo.

and lengthy faunal lists, especially works on deep-sea forms have appeared, as well as important anatomical papers. Important papers on the myriopods appeared in 1883, and of entomological literature there appeared important anatomical and morphological as well as palæontological works and papers, besides some faunal works of value. We shall in another place draw attention to recent discoveries which have not been quoted in our entomological notes. It is enough to take one's breath away to be told that the number of new genera described in 1883 was 1079, while the Arachnida have yet to be heard from.

As we have said in former years the Zoölogical Record is of immediate and pressing value to American students, and it is surprising that more copies are not taken by our working naturalists.

MILLSPAUGH'S AMERICAN MEDICINAL PLANTS.[1]—This is a promising work now issuing in parts, each containing six colored lithographic plates, and from ten to fifteen pages of descriptive text. Upon each plate are shown the characteristic portions of some plant with dissections of the floral organs, or the fruits and seeds. The drawings are generally accurate and the coloring is good. Of course one need not look in a work like this for that degree of accuracy and finish which we are accustomed to see in the drawings by Isaac Sprague, but still they answer their purpose admirably, of enabling the student to identify the different medicinal plants of his flora.

Five parts (composing Fascicle 1) of this publication have already appeared, including thirty plates. The whole work will contain 180 plates, and it is the intention of the publishers to complete it within two years. The low price at which it is offered (five dollars per fascicle) places it within reach of everyone who is interested in the medicinal plants of the country. It will also be found an interesting and valuable addition to the library of the botanist.—*Charles E. Bessey.*

PHILOSOPHIC ZOÖLOGY BEFORE DARWIN.[2]—"The evolution of ideas," says the author in his preface, is much like that of "living beings." They ordinarily arise in an humble way, and lie concealed among older ideas, become confounded with them, but slowly they become differentiated, attain a certain strength, transform and die, after having engendered other ideas of a similar kind." The book is an extremely interesting and suggestive one as will be seen by the following titles of the chapters: first ideas on the place of animals in nature; Aristotle; the Roman period;

[1] *American Medicinal Plants;* an illustrated and descriptive guide to the American plants used as homœopathic remedies; their history, preparation, chemistry and physiological effects. By CHARLES F. MILLSPAUGH, M.D. Illustrated by the author. Boericke & Tafel, New York and Philadelphia.

[2] *La Philosophie Zoölogique avant Darwin.* Par EDMOND PERRIER. Bibliothèque scientifique internationale. XLV. Paris, 1884. 8vo, pp. 292.

the middle ages and the renaissance; evolution of the idea of species; the philosophers of the eighteenth century: Buffon, Lamarck, Geoffrey St. Hilaire, Cuvier. Discussion between Cuvier and Geoffrey Saint Hilaire, Goethe, Dugès, the natur-philosophers, the theory of organic types and its consequences; Agassiz; the lower animals; the cellular theory and the constitution of the individual embryology, the species and its modifications.

CANADIAN GEOLOGICAL SURVEY.—The Canadian Geological Survey has published a descriptive sketch of the physical geography and geology of Canada, which has been prepared to accompany a new geological map of the Dominion on a scale of forty miles to one inch. The description of the eastern section is by the Director of the Survey, Dr. Selwyn, and of the western part by Dr. G. M. Dawson. The maps are a valuable addition to geological science, as embodying the latest explorations of the survey, particularly on the Pacific coast, as also in Newfoundland.

TWELFTH ANNUAL REPORT OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.—The report is mainly devoted to Mr. Herrick's final report on the Crustacea of Minnesota, which has been already noticed in this magazine, and also to Mr. Warren Upham's catalogue of the flora of Minnesota.

RECENT BOOKS AND PAMPHLETS.

Martin, H. N.—A correction of certain statements published in the "Zoöphilist," also a castigation and an appeal. Baltimore, 1885. From the author.

Jackson, A. W.—On the morphology of Colemanite. Bull. Cal. Acad. of Sciences, Jan., 1885. From the author.

Derby, O. A.—Physical geography and geology of Brazil. Rio Janeiro, 1884.

——On the flexibility of Itacolumite. Ext. Amer. Jour. of Science, 1884. Both from the author.

Rice, W. N.—The geology of Bermuda. From Bull. No. 25 U. S. National Museum. Washington, 1884. From the author.

Sharp, B.—Homologies of the vertebrate crystalline lens. Ext. Proc. Nat. Sci., Phil., 1884. From the author.

Frazer, P.—Address read before the Royal Society of Canada, May, 1884. From the author.

James, J. F.—The Fucoids of the Cincinnati group. Ext. Jour. Cin. Soc. Nat. Hist., 1884. From the author.

Kollmann, J.—Hohes Alter der Menschenrassen. Zeitschrift für Ethnologie, Berlin, 1884. From the author.

Ryder, J. A., and Puysegur, M.—Papers on the development and greening of the oyster. Washington, 1884. From the authors.

Geinitz, H. B.—Ueber die Grenzen der Zechsteinformation und der Dyas uberhaupt. From the author.

Crosby, W. O.—Origin and relations of continents and ocean basins. Ext. Proc. Bost. Soc. Nat. Hist.

——On the relations of conglomerate and slate in the Boston basin. Ext. idem.

——On the chasm called "Purgatory" in Sutton, Mass. Ext. idem. All from the author.

Oliver, C. A.—A correlation theory of color perception. Ext. Amer. Jour. Med. Sci., 1885. From the author.

Gardner, J. S.—The age of the basalts of the Northeast Atlantic. Read before the Belfast Nat. Field Club, 1884.

——British Cretaceous Nuculidæ. Ext. Quart. Jour. Geol. Soc., 1884.

——Relative ages of American and English fossil floras. Ext. Geol. Mag., 1884. All from the author.

Robinson, J.—Report of the committee on forest trees. Ext. Proc. Essex Agric. Soc., 1884.

——Botany in Essex county. Ext. Bull. Essex Institute, 1884. Both from the author.

Beecher, C. E.—Some abnormal and pathologic forms of fresh-water shells from the vicinity of Albany, N. Y. Ext. 36th Rep. N. Y. State Mus. Nat. Hist., 1884. From the author.

Willard, S. W.—Migration and distribution of North American birds in Brown and Ontagamie counties. From the author.

Struthers, J.—On the bones, articulations and muscles of the rudimentary hind-limb of the Greenland right whale. Ext. Jour. Anat. and Phys., Vol. xv, 1881. From the author.

Stevenson, W. G.—Does spiritualism transcend natural law? From the author.

Baur, G.—On the centrale carpi of the mammals. Ext. Amer. Nat., Feb., 1885. From the author.

Scott, W. L.—The great white egret and the yellow rail in Ottawa, Canada. From the Auk, 1885.

——The winter Passeres and Picariæ of Ottawa. Both from the author.

Hanks, H. G.—Fourth annual report of the State mineralogist of California, 1884. From the author.

Graff, L. von—Ueber einige Deformitäten fossilen Crinoiden. From "Palæontographica," 1885. From the author.

Dames, W.—Ueber Archæopteryx. Palæontologische Abhandlungen, Band II, Heft 3. From the author.

Deslongchamps, E.—Etudes Critiques sur des Brachipodes nouveaux on peu connus. 1884. From the author.

Collett, J., Cope, E. D., and Wortman, J.—Fourteenth annual report of the State geologist of Indiana. Part I. Geology and natural history. Part II. Post-pliocene Vertebrates of Indiana. From the State geologist.

Topinard, P.—Eléments d'Anthropologie Générale. Paris, 1885. From the author.

Scudder, S. H.—The earliest winged insects of America. Cambridge, Mass., 1885. From the author.

Lydekker, R.—The Labyrinthodont from the Bijori group. Memoirs Geol. Surv. of India. From the author.

Kingsley, J. S., et al.—The Standard Natural History. Vol. I. Lower Invertebrates. Cassino & Co., Boston, 1885. From the publishers.

Winchell, N. H., and Harrington, M. W.—The geological and natural history survey of Minnesota. Vols. IV, VII, X, XI, XII. From the authors.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*The Niger.*—General Faidherbe, in an article upon the "Niger Question," in the *Revue Scientifique*, tells us that the people of the marshy delta, and of the fine country beyond as far as Idda, are fetishists, while from this point Mussulmans dominate.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Lokodja is governed by a prince named by the king of Nupé, himself a satrap of the Sultan of Sokotto. Rabba the capital of Nupé, has 70,000 inhabitants. Above Egga the river becomes shallow, and vessels drawing more than four or five feet cannot proceed to Rabba. The constant falling in of the western bank renders navigation of the Lower Nile difficult. French commercial companies no longer exist on the Lower Niger. The Upper Niger is dominated by three powerful chiefs. The "prophet" Samory, a sort of religiously fanatic slave-hunter, who burns his unmerchantable prisoners, occupies the upper portion. Below him is Amradon, chief of a better organized state, with an army of Tonconleur cavalry and Bambarra infantry, and lastly, between Sansandig and Timbuctoo, comes Tidiani, who, with his bands of brigands, cuts off the communications of the latter once flourishing city.

Timbuctoo has for over 200 years been ruled by a "kahia," a kind of burgomaster originally appointed by the Emperor of Morocco from the Moorish Andalusian family of Er-Rami. The office became hereditary, but the present kahia or Amir Muhammed Er-Rami, who is now in Paris, has little power, and is practically a puppet in the hands of whichever of the rival Arab, Berber or Fulah factions have the upper hand. The Arab chief, Sheikh Abadin, sides with the Fulahs or Fulani, whose power is continually increasing, and who are likely to become absolute masters of Timbuctoo unless it falls into the hands of some European power.

Harrar.—The province of Harrar proper lies in a circle around the city of that name, and has a population, according to Major F. M. Hunter, of nearly 329,000. The city of Harrar is fortified so as to be fairly defensible against native attack, and contains an area of 200 acres, and a population of about 30,000, two-thirds of whom are women, and only about one-third natives of the city. The suburbs contain 6000 more. Harrar is regarded by Professor Keane as an outlier of Abyssinian civilization, and perhaps is a remnant of the ancient kingdom of Adela or Ada, once a powerful enemy of Abyssinia. At any rate it has for centuries preserved within its walls a distinct race, speaking a tongue not understood by its neighbors, and has been the center of trade for the surrounding countries, dispatching caravans to Tajura, Zeila, and Berbera. The city has some 4500 domiciles. Major Hunter gives some details of the material condition, dress, domestic ceremonies, etc., of the women, and refers to the account given by Burton in "First Footsteps in East Africa." Debased Egyptian piastres and Maria Theresa dollars are the only currency, and the only industries are bookbinding and weaving. The principal indigenous exports are coffee, and wars or safflower. Harrar is 286 miles from Berbera, and 182½ from Zeila.

Asia.—*Asiatic Notes, Etc.*—Four French officers, who have journeyed among the Muongs of the Black river of Tonquin, de-

scribe them as more civilized than the Mois of Cochin China. Thev are warlike, intelligent and industrious, and make their own arms. Practically, they are independent, though the Annamites profess to appoint their chiefs. The country is rich in minerals, and some gold fields are worked by Chinese, who permit no stranger to approach.——The commission to investigate the possibility of a canal across the Isthmus of Krao, Malacca, has explored a part of the peninsula before unknown to Europeans. They were conducted to a large inland sea, called Tale-Sab (the name seems identical with Tonle'-Sap, in Cambodia). This lake is forty-five miles long and twelve wide, and has numerous small islands covered with the nests of sparrows. The state of Sam-Sam, composed of mestizos, or half-caste Malays and Siamese, a population somewhat inclined to piracy, exists at about 7° 14′ N. lat. ——Mr. Mueller's reconnaissance survey between Cascade plateau and Lake McKerrow, on the west coast of the middle island, New Zealand, has shown that a great part of the Hope range is auriferous, while traces of gold occur along the whole length of Gorge river. The most remarkable geological feature is the Olivine range, a red-violet mass devoid of almost every trace of vegetation from about 1000 feet above the Cascade river.

EUROPE.—*European Notes.*—The Norwegians have discovered several new islands to the east of King Karl or Wiche land. In 1884 the west side of Spitzbergen was blocked by a belt of land-ice, the whole summer through, while the east side, which is usually blocked, was more open than for many years. The prevailing direction of the winds appear to cause these changes. Observations prove that the level of the shores of the Baltic is changing with considerable rapidity, the northern shore rising, while the southern is sinking. The northern part of Sweden has risen seven feet in the last 134 years, but the rise diminishes southward until at the Naze it is only one foot, and at the island of Bornholm nothing. The line of equilibrium passes along the islands of Bornhohm and Gothland.——The Brussels National Institute of Geography is now publishing a *fac-simile* reproduction of the plans of a hundred Belgian towns drawn up between 1550 and 1565, by J. de Deventer, at the command of Charles V and Philip II, of Spain. The originals are divided between the libraries at Brussels and Madrid.

AMERICA.—*Physical Aspect of Brazil.*—The greater part of Brazil is an elevated plateau, having a main elevation of from one to more than three thousand feet. This great plateau is bounded northward by the great Amazonian depression, westward by the basin of the Paraguay, which is continued northward by that of the Guaporé, a tributary of the Madeira, and all along the ocean border by a narrow strip of coast. North of the great Amazonian valley rises a second smaller pleateau, continuous with that of

Guiana. The sketch map of Brazil, prepared by O. A. Derby for Vol. 1 of La Geographica physica do Brazil is a revelation to those whose knowledge of Brazil is mainly confined to the Amazons. Not one-tenth of the entire country, according to this map, is less than 300 meters above the sea, and the region above 1000 meters is at least half as large as those below 300. The true mountains of upheaved strata are mainly in the eastern and central portions of the Brazilian plateau, and may be considered as forming two groups, separated by the elevated table lands of the Parana and Sao Francisco basins. The culminating points of the eastern group are the peaks of the Organ mountains in the Serra do Mar, and Itatiaia (2712 meters), the highest point in the empire. The western group consists of at least two distinct ranges, culminating in the Montes Pyreneos near Goyaz. The great table-lands, though composed of horizontal strata, are often so excavated by the deep river valleys as to have the appearance of mountains. On their eastern border, in the provinces of Parana and São Paolo, they rise to 1000 meters. The water-parting between the rivers flowing south and those flowing north is partly formed by a transverse ridge across the southern part of Minas Geraes, connecting the two groups of mountains. The Tocantins, Xingu, Tapajos, and Madeira, all descend from the tableland in a series of rapids at from 100 to 200 miles from the Amazon. The Brazilian portion of the Guiana plateau is very imperfectly known, but some spurs of its highlands extend to within a few miles of the Amazons between the mouth of the Rio Negro and the ocean.

American Notes.—The Ona of Terra del Fuego are estimated by Lieut. Bove at from 300 to 400, and the total number of Fuegians, men, women and children in the archipelago, according to a careful census made by the English missionary, the Rev. T. Bridges, is given as 949.——Mr. E. M. Thurm telegraphed to Kew that he has succeeded in ascending Roraima.——Capt. Eduardo O'Connor has navigated the Rio Negro of Patagonia from its mouth in the Atlantic to its source in the romantic Lake Nahuel-Hualpi in the Chilian Andes. He was able to proceed by steamer as far as the confluence of the Colhincura' or Catapuliche, but beyond that point was compelled to make his way in an open boat. The Upper Limay, the furthest southern headstream of the Rio Negro, flows over numerous rapids in a narrow rocky bed, contracting at some points to 120 or even 100 feet. In 40° 42′ S. lat., beyond the confluence of the Treful, the rapids disappear, the stream is deeper and less swift, and navigable for steam launches to the lake. The scenery of the alpine basin of the lake is represented as charming. The country around appears to be uninhabited.——The Indians who inhabit that part of the Chaco, to which the Argentine government has sent an expedition, are supposed to number about 10,000. Their weapon is the arrow,

and, when hunting and fishing fail, they live on locusts and on stolen cattle. It is hoped that the Rio Bermejo will be found to be navigable after its junction with the Tenco.——Dr. Claus left Cuyaba, in Matteo Grosso, in May, 1882, navigated a small river to its junction with the Xingu, and followed the latter to its mouth.

Lake Mistassini.—A letter to *Science*, from A. R. C. Selwyn, Director of the Geological Survey of Canada, states his belief that Lake Mistassini consists of several almost separate lakes, but that the entire body of water is not to be compared with that of Lake Superior. The exploration of the region was commenced in 1870–71, and last spring a party was despatched to continue the work. The sensational article in the *Montreal Witness* arose out of an interview of a reporter with Mr. F. H. Bignell, who had just returned from taking winter supplies to the exploring party. The communication of Mr. Selwyn is accompanied by a tracing of Eugene Tache's map of the province of Quebec, the only map upon which the results of the surveys of 1870–71 are correctly laid down. Geologically the lake lies in a basin of flat lying limestones, probably of Lower Cambrian age, resting on Laurentian and Huronian rocks.

DR. CARVER. A CORRECTION.—In your March number, p. 231, an error crops out in "Carver the celebrated *English* traveler."

According to the North American Cyclopedia, "he was an American traveler, born at Stillwater, Connecticut, in 1732."

The notice proceeds with an incorrect statement, viz., "He crossed the continent to the *Pacific*, and returned to Boston in 1768, having traveled about 7000 miles."

Whereas, with a plan to go to the Pacific, he left Boston in June, 1766, went by the lakes, Green bay and Fox river portage to and up the Mississippi and the sources of St. Peter's river, where he wintered. He returned in the early summer of 1767 to Prairie du Chien, and in June, went, via the Mississippi and Chippewa rivers, &c., &c., to the north side of Lake Superior, coasted down to Sault St. Marie, then to Michillimackinac, where he spent the winter. "The next season he arrived in October, 1768, at Boston, after an absence of two years and five months, and a journey of near 7000 miles," p. 111.

See his Travels, Philadelphia, 1796, for which there were about 1600 subscribers whose names are given.

Two editions (p. 1) seemed to have appeared under his care, and the one in Philadelphia was a third.—*O. P. Hubbard, 65 W. 19th street, New York.*

GEOLOGY AND PALÆONTOLOGY.

THE MAMMALIAN GENUS HEMIGANUS.—This genus was characterized by me in the NATURALIST for 1882, p. 831,[1] from a number of teeth. The typical species, *H. vultuosus* was supposed to be a beast of about the size of a tapir. Its exact position was not determined. Jaws with teeth and a part of the skeleton of a second and smaller species of the genus recently received, throw much light on its characters, and demonstrate that it is one of the most remarkable of the Eocene Mammalia yet discovered.

The claws are large and compressed like those of a prehensile-footed carnivore. The astragalo-tibal articulation is nearly flat. The femur is very robust, and has a low third trochanter, as in Bunotheria generally. The vertebræ of the neck are short and wide. The jaws have a very large and wide coronoid process, as in Calamodon, and the horizontal rami are very robust. The molar teeth of the lower jaw have but one root. Only one true molar (the first) is preserved, and it has the crown worn. Its outline is sub-round, with a notch on the internal side, There are probably four premolars, and their crowns are short, obtuse cones, with a low heel-like expansion at the inner side of the posterior base. They resemble very nearly the teeth of some of the eared seals. There is a robust canine tooth in the upper jaw, which is not separated from the premolars by a diastema. There is at least one superior incisor, but the exact number is unknown. There is a large tooth on each side of the symphysis of the lower jaw, but in the specimens it is not in place. It has enamel on the anterior face only, and its apex is worn transversely. The wear descending passes to one side of the middle line. It evidently has a median position, and may therefore be an incisor. Its form reminds one of that of the second inferior incisor of Calamodon, but the enamel-face is much shorter.

Should the large inferior teeth be canines, the mandibular dentition will greatly resemble that of the seals, as does that of the maxillary bone. The absence of postorbital angles resembles the condition in the Phocidæ. The wide vertical coronoid process and the flat vertical angle are as in Calamodon. The sagittal crest is elevated, and the brain-case very small.

Hemiganus may for the present be referred to the Creodonta where it will stand quite alone, and next to the Tæniodonta.

The species which is represented by the specimens referred to; may be called *Hemiganus otariidens.* It may be characterized as follows: Enamel of teeth everywhere smooth. Posterior true molars smaller than the anterior. Diameter of crown of M. 1: transverse .008; anteroposterior .008. Diameter of large inferior ? incisor at shoulder: anteroposterior .017; transverse .008. Depth of ramus at P-m. III .040; at coronoid process .090; length

[1] It is figured on Plate XXIII *c*, figs. 7–12, Report U. S. Geol. Survey Terrs., III.

of ramus posterior to P-m. III inclusive .106. From the lowest beds of the Puerco epoch. D. Baldwin.—*E. D. Cope.*

MARSUPIALS FROM THE LOWER EOCENE OF NEW MEXICO.—Two families undoubtedly referable to the Marsupialia have been identified from the Puerco Eocene, the Polymastodontidæ and Plagiaulacidæ (see NATURALIST, 1884, p. 686, for an account of these animals). One genus of each is known, viz., Polymastodon and Ptilodus. I now add a third genus in the Neoplagiaulax of Lemoine, which belongs to the Plagiaulacidæ, and has been represented hitherto by a single species from the Puerco beds of Rheims, France. The American species is very distinct from the European, and comes from the base of the formation in New Mexico. I describe it as follows:

Neoplagiaulax americanus.—Size a little exceeding that of the *Ptilodus mediævus*, and many times larger than the *N. eocænus* Lemoine. The large fourth premolar is less elevated than in the two species mentioned. Its cutting edge is obtusely serrate, and the lateral keels though fine, as in *P. mediævus*, are only seven in number instead of twelve. The posterior base wears into a little truncation. The molars are much as in the species named. The tubercles are coarse and number four on each side on the first, and two on each side on the second. The incisor is much compressed, and the enamel band is perfectly smooth. The coronoid process rises opposite the second tubercle of the first true molar. Measurements: Length of base of P-m. IV .012; elevation of crown of do. .006; length of bases of molars .009; of first true molar .006. Depth of ramus at middle of P-m. IV .011; at diastema .008. Depth of incisor at middle .006; width of do. at do. .003. D. Baldwin.

Ptilodus trovessartianus Cope, Report U. S. Geol. Survey Terrs., III, p. 737, Pl. XXV *f*, Fig. 19.—Two mandibles of this species, found by Mr. Baldwin, are in excellent preservation, including both the two premolars and the two true molars, and showing that the species belongs to Ptilodus rather than to Neoplagiaulax. Besides its inferior size, this species differs from the *P. mediævus* in the smaller second true molar. The tubercles of this tooth are two on each side; in the *P. mediævus* they are four on one side and two on the other. It comes from the middle horizon of the Puerco.

Polymastodon taoënsis Cope: *Tæniolabis scalper* Cope, Report U. S. Geol. Surv. Terrs., III, p. 193, Pl. XXIII *d*, Fig. 7.—The genus Polymastodon is found in the lowest horizon of the Puerco in abundance, but is rare, if present, elsewhere in the formation. Specimens of the species above mentioned include incisors of the kind which furnished the typical description of the *Tæniolabis scalper*, with superior molars of this genus, and probably of the species *P. taoënsis*, of which several undoubted specimens were

found by Mr. Baldwin at the same locality. *T. scalper* was probably founded on superior incisors of *P. taoënsis.*

Polymastodon attenuatus, sp. nov.—This form is represented by a mandibular ramus with entire dentition, of one individual, and by a superior incisor with portions of inferior molars of a second. The specific character is seen in the very compressed incisors and general lightness of structure of the ramus, in which it is quite different from the species of similar size, the *P. taoënsis* and *P. latimolis* (NATURALIST, April, 1885). The tubercles and proportions of the true molars are as in *P. taoënsis.* The apex of the fourth premolar is transversely fissured. The superior incisor is much more compressed than in that of *P. taoënsis*, and is more rapidly acuminate in its form, to the subacute apex. There are no facets of the internal side as in that species. The enamel covers almost the entire external face, and is marked by rather coarse parallel grooves. A groove runs along the concave edge of the crown, forming the edge of the enamel excepting for its distal half, where the enamel crosses it, and covers the internal side for its distal fourth. The inferior incisor is also much compressed so that the enamel is presented externally rather than anteriorly, and its cutting edge is nearly anteroposterior and not transverse, as in *P. taoënsis.* Its surface is obsoletely grooved. Length ot superior incisor .25; diameters do. at middle: anteroposterior .013; transverse .006. Length of inferior true molars .032; depth of ramus at middle M. 1. .034.—*E. D. Cope.*

THE LOUP FORK MIOCENE IN MEXICO.—A considerable extent of tertiary deposit in the State of Hidalgo and the adjoining parts of Vera Cruz has been announced by Professor Antonio de Castillo in the report of the School of Mines of Mexico for 1883. I recently visited the region, and obtained from the beds bones and teeth belonging to species of Protohippus, Hippotherium and Mastodon, and probably Procamelus; and Professor Castillo has teeth of Dicotyles. It is thus evident that the horizon is the Loup Fork or Upper Miocene of the North American series. This is by far the most southern exhibition of this formation, the nearest locality which I have identified with it being in New Mexico. In its Mexican area it occupies a tract of at least eighteen miles by six, which at present presents an extremely irregular surface. It is excavated into numerous valleys of erosion by tributaries of the Tuxpan and Benados rivers, some of which are fifteen hundred feet in depth and quite narrow. The axes of the high lands consist of trap, which in some instances are dykes, as the limestones of palæozoic or mesozoic age lie against them inclined at high angles. Some of these traps inclose masses of obsidian of various sizes. The entire Loup Fork formation is now not less than two thousand feet in thickness, as it not only fills the valleys but also caps the traps. Several thin beds of coal occur in it, both above and below the escarpments of trap; in the latter case

frequently dipping at a low angle towards the trap. Between the coal beds are shales apparently composed of volcanic ash, and beds of excellent clay. The country is covered with vegetation ranging from that of the *Tierra fria*, with pines, oaks, Liquidambar, Platanus, Alnus, Negundo, etc., to the moderate *Tierra caliente*, with oranges, Zamias, Cereus, etc. The fossils are only found in making artificial excavations.—*E. D. Cope.*

Discovery of an Extinct Elk in the Quaternary of New Jersey.—Professor William B. Scott, of Princeton, made (reports *Science*) a communication on an extinct elk, a skeleton of which was recently found in the quaternary of New Jersey. The bones, which are in a state of remarkable preservation, were dug from a bog near Mount Hermon. They were at first supposed to belong to a moose, but, on further examination, it was seen that the skeleton was that of a remarkable form of deer-like animal, between the genera Cervus and Alces, and the name Cervalces was therefore proposed for it. Among other peculiarities, the animal was characterized by long legs and short neck, indicating that it was fitted to progress rapidly through the snow, and that it was not a grazing animal, but obtained its food by browsing on trees as does the moose. Its long nasal bones, however, indicated that it was not provided with the long, fleshy lips of the moose, which amounts almost to a probocis, and that it was therefore at a comparative disadvantage in gathering its nourishment from the branches of trees. The antlers of the specimen are still in the velvet, indicating that the individual probably died in September. They are provided with curious scoop-shaped processes at the base, which, when the head was lowered, must have actually obscured lateral vision. The use of these processes, the presence of which to all appearances was simply a disadvantage to the animal, cannot be determined. The form is peculiarly interesting as illustrating at least one link between two markedly divergent genera, and as suggesting their line of descent. The speaker dwelt at length on the adaptations of structure to surroundings, and gave in detail the diagnostic characters of Alces, Cervus and Cervalces. His remarks were illustrated by photographs and diagrams.

Tertiary Man at Thenay.—The most interesting question brought before the geological section of the French Association was the existence of man in the tertiary epoch. In 1867 the Abbé Bourgeois found at Thenay (Loir et Cher) some flints which he believed to be worked by man or split by fire. Extensive excavations were made at Thenay, which is about twenty kilometers from Blois, and forty members of the Association repaired thither to examine the locality. Comparison with the surrounding strata showed that the bed (of greenish clay mixed with small flints) in which the presumably worked flints occurred, was an upper

stratum of the argillaceous flint-bed which everywhere underlies the Beauce limestone, and therefore is early miocene or even eocene. Only two flints were found which bore the apparent impress of human handiwork, but the splitting which has been attributed to fire, was more common. The great majority of the members concluded that, considering the enormous extent of the beds, the rarity of the peculiar flints found and their unknown use, and the possibility that the effects, like those of fire, were produced by some unknown natural cause, there was nothing to warrant a belief in the existence of man at so remote a period.

A map of the environs of Blois constructed for the geological map of France, and presented to the Association, shows that the Beauce limestone was deposited in a lake, while the clay, with flints, passes beneath the limestone and forms the borders of the lake.

GEOLOGICAL NOTES.—*General.*—It appears from Dr. R. D. M. Verbeek's atlas and description of Sumatra, between 0° 14″ and 1° S. lat. and 99° 45′ and 101° 25′ E. long., that productive coal is wanting in the explored district, and that mesozoic beds are also lacking. The Eocene lies upon the Carboniferous, and the newer Tertiary strata appear to be wanting in the same area. The conclusions arrived at concerning the geology of the island, are that at the end of the Eocene or beginning of the Miocene, an eruption of andesite from fissures occurred in Sumatra, Java and Borneo, contemporaneous with the uplifting of the highlands of Padang. In Bencoolen, Lower Miocene beds overlie this andesite, and at the same spot Middle and Upper Miocene and Pliocene strata also occur. The Pliocene marl shows no trace of newer eruptive materials, while the overlying Quaternary consists of clay and andesite material. In Java, also, the Eocene strata are broken through by andesites and basalts, and the probably Miocene strata which overlie the orbitoides limestone contain andesite materials. The great craters are more modern than the fissure-poured andesite, and between them intervened a period of comparative calm. The commencement of the activity of these volcanoes cannot be fixed with certainty, but was probably nearly quite at the end of the Tertiary period.

Carboniferous.—M. Dieulafait has conducted a series of experiments upon recent Equisetaceæ, with a view to ascertain the reason why coal is always impregnated with sulphur, and why coal ashes do not contain free carbonates of the alkalies, such as were general in the ashes of recent plants. He finds that modern Equisetaceæ contain a proportion of sulphuric acid very much in excess of that contained by other recent plants, and arrives at the conclusion that, as the flora of the Coal Measures was largely composed of Equisetaceæ, it is to them that the great quantity of sulphur and sulphate of lime is due. The absence of

alkaline carbonates in the ashes of coal is a natural consequence of the excess of sulphate of lime always present in the ashes.——Johann Kusta describes *Anthracemartus krejcii*, a new Arachnid from the Carboniferous of Bohemia. H. B. Genitz describes Krerscheria, a pseudo-scorpion.

Permian.—An impression of a terrestrial shell (*Dendropupa walchiarum* Fischer) has been found in the Permian beds of Saone et Loire. This is the only terrestrial mollusk of Carboniferous age that has yet been found on the European continent. *Dendropupa vetusta* was described in 1853 by Dawson, from trunks of Sigillaria in Nova Scotia, and several other Devonian and Carboniferous pulmonates have since been found in America.

Tertiary.—Johann Kusta enumerates three species of Hyopotamus and two of Anthracotherium from the Hempstead beds of the Isle of Wight.——W. Davies has verified the occurrence of Hyaenarctos in the Miocene strata of Pikermi near Athens.——W. Davies (*Geol. Mag.*, Oct., 1884) describes *Viverra hastingsiæ* and remains of two other carnivores from the Eocene fresh-water beds of Hordwell, Hampshire.——J. S. Gardiner describes (*Geol. Mag.*, Dec.) six species of Aporrhais, all belonging to an ancestral type of the recent *A. pes-pelecani*, from the Eocene of Great Britain.——R. Lydekker describes a new species of Merycopotamus (*M. nanus*), from examples in the British museum.

Quaternary.—Entire skeletons of the cave hyæna are rare, for these animals devoured the bones of their own as well as of other species. Recently M. F. Regnault, of Toulouse, has descended into a cavity twenty meters deep in the grotto of Gargas, Hautes Pyrenees, and has found entire skeletons of hyænas, bears and wolves, the position being such that the hyænas could not get at the bones to devour them. From examination of these bones, M. Alb. Gaudry believes that *H. spelæa* is but a variety of *H. crocuta*.

MINERALOGY AND PETROGRAPHY.[1]

WADSWORTH'S LITHOLOGICAL STUDIES, PART I.[2]—This handsomely printed quarto volume of over two hundred pages and many colored plates, at first glance promises, both from its title and general scope, to be a most valuable addition to the literature of petrography; nevertheless a careful study of its contents fails to discover as much that is new and useful as was at first expected. The work aims to be an exhaustive and critical revision of all the petrographical work hitherto accomplished as well as an attempt to rearrange the same in accordance with the author's

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore, Md.

[2] Lithological Studies, Part I. A description and classification of the rocks of the Cordilleras. By M. E. Wadsworth. 4to, with 8 colored plates. Memoirs of the Museum of Comp. Zoölogy at Harvard College, Vol. IX, Oct., 1884.

somewhat peculiar views. The petrographical descriptions are, however, largely taken from the work of others, while those which are original are not sufficiently detailed; the generalizations are often broader than the facts thus far accumulated would seem to warrant; and even the statement of the writer's most original ideas regarding rock nomenclature and classification is not in certain points altogether free from ambiguity.

Chapter first, containing nine sections, deals with the interior structure of the earth; the origin and alterations of rocks and of their constituent minerals; the methods of rock-classification hitherto followed and their defects, and lastly, the proposal of the author's system of classification.

Sedimentary and eruptive rocks are held never to grade into one another, as sometimes appears to be the case. Each class possesses field and microscopic characteristics sufficiently marked to make their separation possible, although by alteration they may come to much resemble each other. All eruptive rocks of the same chemical composition were alike at the time of their formation; the present differences in structure, etc., are due mainly to the alteration of the older ones. The minerals tend to constantly pass from less stable compounds to those which are more stable for the conditions now existing on the earth. The alteration therefore varies with the age, and also, under the same conditions, inversely as the amount of silica which the rocks contain. Foliation or schistose structure is no necessary proof of the sedimentary origin of a rock. Inasmuch as the alteration of a rock goes on in some cases much more rapidly than in others, lithological character can be regarded as no index of age.

The mineral constituents of an eruptive rock are divided into three classes: 1st, those present in the magma before its extrusion (foreign); 2d, those formed at the time of the consolidation of the magma (indigenous); 3d, alteration products (secondary). The first class is regarded as composed entirely of foreign inclusions, no account being taken, as it seems, of such minerals as leucite, olivine, etc., which may crystallize out of the molten magma long before it is extruded or solidifies! Hornblende appears to be regarded as always belonging to either the first or third class.

The present systems of rock-classification, based on chemical composition, structure, mineral constituents and geological age, are reviewed in turn and pronounced artificial and unsatisfactory. Section VIII contains the statement of thirteen principles which the author thinks should underlie a natural classification of rocks. It must be confessed, however, that this attempt is not altogether satisfactory. It is stated that *all* the petrological (field), lithological (microscopical) and chemical characters of a rock must be used in determining its species, but in what way is not made clear. Mineral composition is sufficient to define varieties but not species. All rocks which may be followed from one form to

another, whatever be the changes of chemical or mineral composition or of structure, *within certain limits*, form a species; but what these limits are is not stated. A diorite derived by paramorphosis from a gabbro must be called a gabbro. Even quartz which might have replaced a basalt would have to be called basalt, strange as this would seem, unless these "certain limits" be defined. Wadsworth's classification seems to be, after all, mainly a chemical one in which the rocks of approximately the same composition, but differing in their constituents, structure or degree of alteration are arranged under the principal species as varieties.

Chapter second commences the systematic treatment of rock classes, starting with the most basic. The suggestion of Reyer, to consider the meteorites as eruptive rocks more basic than any normally found near the earth's surface, is wisely followed. Species I, Siderolite, is made to include all masses of iron, either native or in its secondary state as magnetite, hematite, etc., which are not of chemical or secondary origin. This species is of course principally represented by meteoric iron. Species II, Pallasite, includes such original, eruptive, celestial or terrestrial rocks as contain a large amount of native or oxidized iron inclosing other minerals. Twenty-two meteoric pallasites are mentioned. As a terrestrial variety of pallasite is described the so-called "cumberlandite" from Rhode Island, an apparently eruptive mass of magnetite full of crystals of olivine, feldspar, etc. Analogous to this is Sjören's "magnetite-olivinite" from Taberg, in Sweden.

Chapter third deals with Species III, Peridotite. This name was given by Rosenbusch to massive rocks composed essentially of olivine together with various pyroxenic minerals. The author classifies these as follows:

Variety 1.	*Dunite*	= olivine + picotite.
" 2.	*Saxonite*	= olivine + enstatite.
" 3.	*Lherzolite*	= olivine + enstatite + diallage.
" 4.	*Buchnerite*	= olivine + enstatite + augite.
" 5.	*Eulysite*	= olivine + diallage (= "Wehrlite").
" 6.	*Picrite*	= olivine + augite.

Serpentine is derived by alteration from all of these.

Eulysite is a name that was originally applied to a rock very rich in garnet, and it is difficult to see why it is preferred to the German term wehrlite, used for olivine-diallage rocks. Forty meteoric peridotites are enumerated, following which is a section devoted to the origin and character of meteorites in general. The "chondri" are regarded as spherules due to crystallization, and the meteorites themselves as having probably been thrown off by the sun. Then succeeds the description of many terrestrial peridotites and serpentines, with general remarks on their character and origin. Considerable space is devoted to the relations be-

tween picotite and chromite. Both are translucent with a brown color when sufficiently thin, but the latter only with considerable difficulty. The suggestion is made that the chromite may be an alteration-product of picotite.

Chapter fourth deals with the fourth rock-species, Basalt, of which, however, only such as are of meteoric origin are treated in the present portion of the work. Pages I–XXXIII at the close of the book contain valuable tables of all the chemical analyses hitherto made of the rocks described. Eight plates with forty-eight colored figures represent the microscopic structure of these same rocks in an admirable manner.

MINERALOGICAL NOTES.—*Quartz.* Professor G. vom Rath,[1] of the University of Bonn, has recently made a valuable contribution to the literature of American mineralogy by his studies of the quartz crystals from Alexander county, N. C., material for which was loaned him by Mr. C. Bement, of Philadelphia, and Mr. G. F. Kunz, of Hoboken. The crystallography of these quartzes is very varied and complicated, and the writer does not hesitate to pronounce this American locality the most interesting one thus far known in the world. The tetartohedral character of this mineral is frequently shown by the large development of the trigonal trapezohedron $-\frac{\frac{3}{2}\,P\,\frac{3}{2}}{4}$. Complicated twins and many acute rhombohedrons, especially 3R, are also common.——The same paper contains the description of tridymite from Krakatoa, in which the opinion is expressed that, as Merian has already suggested (vid. NATURALIST, March, 1885, p. 300), the form of this mineral is hexagonal, its optical anomalies being due to molecular disturbance produced by a change of the conditions under which the crystals were formed.——Much new material has been received regarding the mineral colemanite, mentioned in the March NATURALIST, which occurs in the southern part of Death valley, Inyo county, California. An exhaustive monograph on its crystallography, by Professor A. Wendell Jackson,[2] enumerates thirty-eight forms (of which $\frac{68}{11}\,P\,\overline{\infty}$, given in the *Am. Jour. Sci.* for Dec. is not one). Of these fourteen were independently observed by vom Rath,[3] and twenty by both Hjortdahl,[4] of Christiania and Arzruni[5] of Breslau. Vom Rath and Bodewig give the plane of the optical axes as perpendicular to $\infty\,P\,\dot{\infty}$, making an angle with $\frac{1}{c}$ in the obtuse angle β of 82° 42′, for so-

[1] Mineralogische Notizen. Verhandlungen des Natur. Vereins d. preuss. Rheinland und Westph., 1884. Bonn, 1885.

[2] Bulletin of the California Academy of Sciences, No. 2, Jan., 1885.

[3] Verhandlungen d. Natur. Vereins d. preuss. Rheinland and Westph., p. 333, 1884.

[4] Zeitschrift für Krystallographie, Vol. x, 1885, p. 25.

[5] Verhandlungen d. Natur. Verein d. preuss. Rheinland and Westph., p. 342, 1884.

dium light. The real optical angle, $2V_a$, is 55° 20′. These results agree very closely with those obtained by Hjortdahl.——Hans Thürach[1] has contributed an interesting paper on the wide distribution of zircon and certain titanium minerals as microscopic rock-constituents. Decomposed rocks were especially investigated, from which these minerals were the more easily separated. Rutile, anatase, brookite and pseudo-brookite were all identified. Tourmaline, staurolite, garnet and some other minerals are also spoken of in the same connection, and a long list of localities given where all these substances were observed.——Kalkowsky[2] finds that in certain rocks, especially nepheline-basalts from Randen in the Hegau, Baden, and from Tharand in Saxony, twins of olivine are quite common. The twinning plane is a brachydome whose angle over OP is nearly 60°, as was observed by vom Rath in free crystals of monticellite from Mte. Somma.——Knop[3] has made a thorough chemical study of the augite occurring in the various rocks of the Kaiserstuhl in Baden. One group is interesting on account of their containing TiO_2, the amount sometimes exceeding four per cent. This would naturally be supposed to isomorphously replace SiO_2, but on account of the violet color of the augite in which titanium is most abundant, it is suggested that this element may also be present as Ti_2O_3, replacing ferric iron.——Schuster[4] adds over 200 pages to his former paper on the crystallography and structure of danburite, making his numerous and careful measurements the basis of general conclusions regarding the nature of forms possessing very large indices, to which Websky has applied the name "*vicinal-planes.*" For the many important results obtained, reference must be made to the original article. Vicinal-planes are found (p. 490) to possess a definite relation to some principal plane having simple indices, with which they are associated. This relation is a genetic one. Vicinal-planes are regarded, so to speak, as "induced" by the joint action of two forces, one exercised by the new molecules in their effort to form a really new plane and the other exerted by the old plane to retain its exact position.——The crystalline form of the element thorium has been for the first time determined by Brögger.[5] Although apparently rhombohedral, the minute crystals (only 0.15^{mm} wide and 0.015^{mm} thick) are really regular, being a combination of a cube and octahedron.——Schaeffer[6] describes a new American locality for tantalite, the Etta tin mine in Dakota. Its composition is $TaO_2 = 79.01$; $SnO_2 =$

[1] Ueber das Vorkommen mikroskopischer Zirkone und Titan-mineralien. Würzburg, 1884.

[2] Zeitschrift für Krystallographie, Vol. x, p. 17, 1885.

[3] Zeitschrift für Krystallographie, Vol. x, p. 58, 1885.

[4] Tschermak's Min. und Petr. Mittheilungen vi, pp. 301-515, 1885.

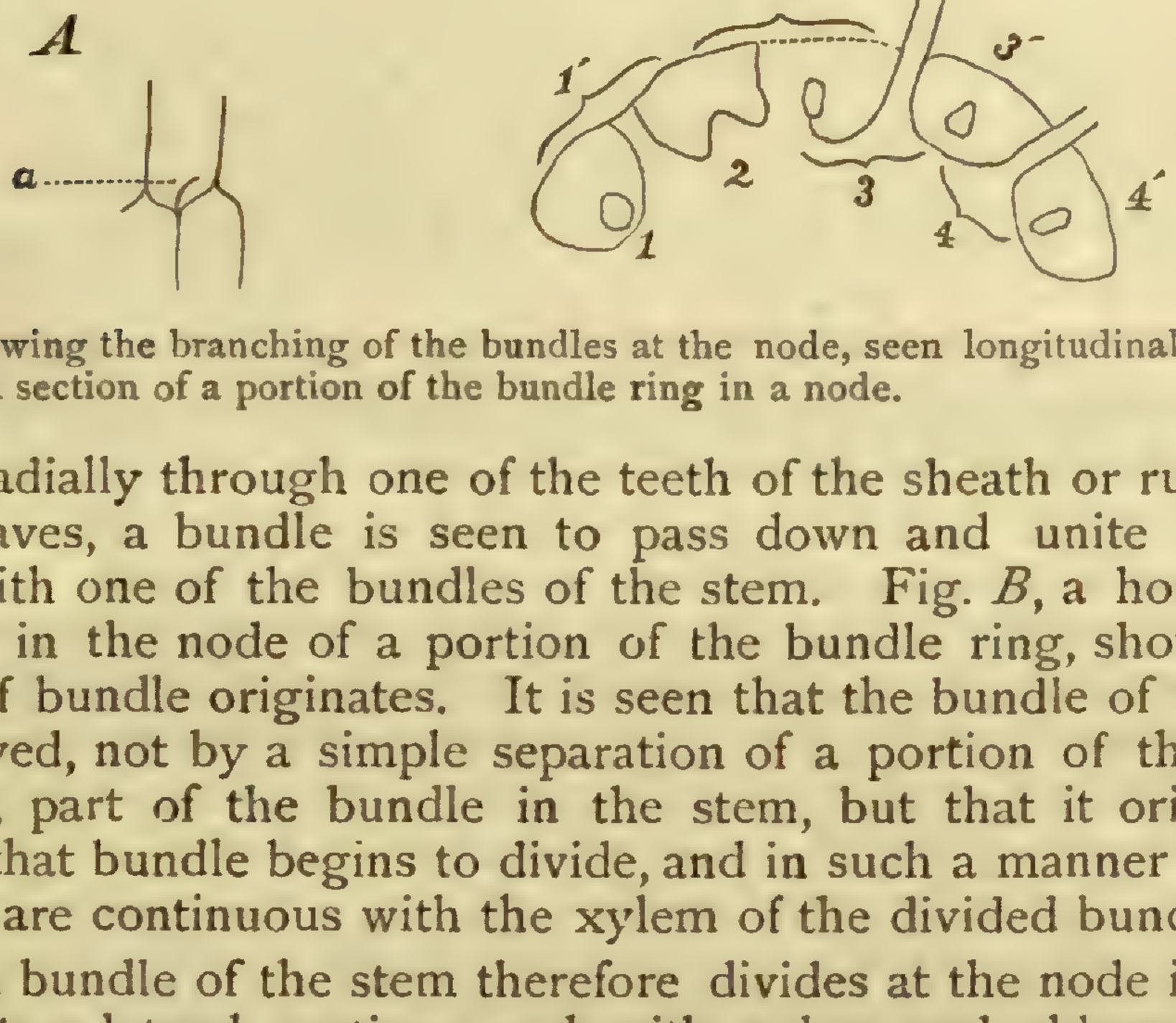
[5] Meddelanden från Stockholms högskola, No. 1, 1883.

[6] American Journal of Science, Dec., 1884, p. 430.

0.39; FeO = 8.33; MnO = 12.13; total 99.86. Sp. gr. = 7.72. ——Hidden[1] mentions a new locality in Colorado for phenacite, xenotime and fayalite, also another for rutile, emerald and hiddenite (spodumene). A crystal of zircon from Burgess, Canada, gave the same author a new plane ⅓P not hitherto observed in this mineral.

BOTANY.[2]

THE NODE OF EQUISETUM.—If a section is made lengthwise through a node of a fertile stem of *Equisetum arvense*, each vascular bundle is seen to divide into two parts, each part uniting with a corresponding part of an adjacent bundle to form one of the bundles of the next internode (Fig. *A*.). If the section be



A. Showing the branching of the bundles at the node, seen longitudinally. *B*, a horizontal section of a portion of the bundle ring in a node.

made radially through one of the teeth of the sheath or rudimentary leaves, a bundle is seen to pass down and unite in the node with one of the bundles of the stem. Fig. *B*, a horizontal section in the node of a portion of the bundle ring, shows how this leaf bundle originates. It is seen that the bundle of the leaf is derived, not by a simple separation of a portion of the outer phlœm, part of the bundle in the stem, but that it originates where that bundle begins to divide, and in such a manner that its vessels are continuous with the xylem of the divided bundle.

Each bundle of the stem therefore divides at the node in three parts—two lateral portions, each with xylem and phlœm, which by rearrangement continue the bundles of the stem, and a central part which bends outward into the leaf.

In Fig. *B*. bundle 3 has divided, and given origin to the leaf bundle *a*, and two lateral portions, one of which has united with half of the divided bundle 4 to form the perfect bundle 3′, the other half being ready to unite with half of the dividing bundle 2 to form a bundle at 2′. A section a very little farther up would show bundle 2′ completed and bundle 2 in the condition that 3 now is. As the leaves do not arise quite on the same horizontal plane successive sections show the process repeated both to the

[1] American Journal of Science, March, 1885, p. 249.

[2] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

right and left until the opposite side of the stem is reached, and as many leaves have been produced as they are bundles in the stem.—*A. A. Crozier, Botanical Laboratory, University of Michigan.*

DISPERSION OF SPORES IN A TOADSTOOL.—A few days since I collected specimens of *Agaricus illudens* for use in my class in botany. I placed the fungi on my table to remain over night that I might in the morning be able to show the color of the spores. What was my surprise on examining my specimens in the morning to find spores in great abundance, not immediately beneath the pileus, but shot out in every direction to the distance of from six to twelve inches, and I know not how much further, as the greater distance named reached the edge of my table. In one direction a roll of paper interrupted the flight of the spores, and from the surface of the paper the little bodies were reflected back in the direction of their origin, and falling finally upon the table formed quite a little drift of accumulated spores, thus showing that the projectile force in operation was strong enough to cause at a considerable distance a very decided rebound.

Such means for the disposal of the spores I have never before observed either in connection with this or any other agaric, nor have I seen notice of such a phenomenon. The atmosphere of my room was at the time very dry, and this fact undoubtedly had something to do with the remarkable distribution described.—*—T. H. McBride, Iowa City, Oct., 1884.*

THE FERTILIZATION OF CUPHEA VISCOSISSIMA.—The entire plant is clammy pubescent, especially the stems and calyces. There are six petals, purple, the two upper ones about twice the size of the rest, the four lower ones being placed along the lower edge of the calyx (Fig. 1 *A*). The lower part of the calyx near the throat is inflated, and the base is spurred (Fig. 1 *B*). On the

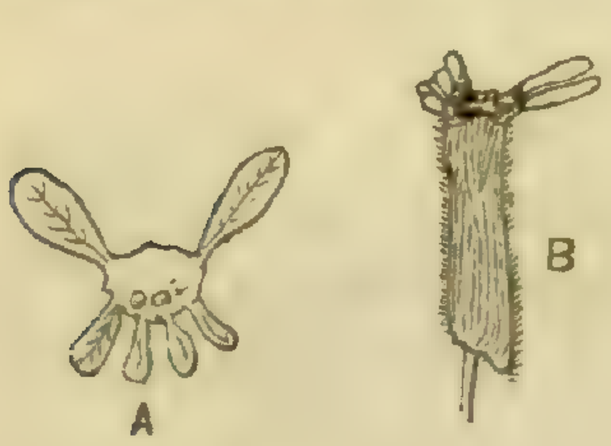


Fig. 1.

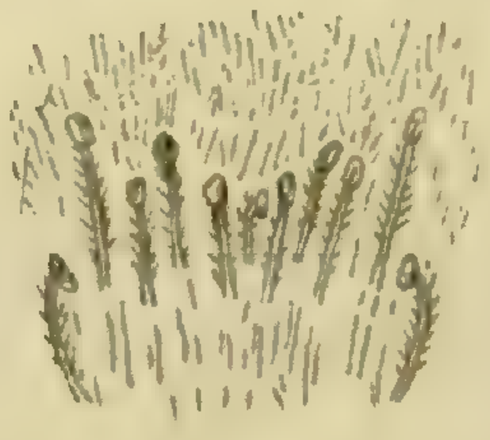


Fig. 2.

Fig. 3.

Cuphea viscosissima. × 1¼.

FIG. 1.—*A.* View of corolla from above. *B.* Side view of flower. FIG. 2. Corolla split open to show the relative position of stamens, magnified. FIG. 3. The pistil. *n*, nectary, *st*, stigma, *o*, ovary.

lower part of the calyx near the inflated portion are inserted the stamens at different heights, generally eleven, the two outer ones being decidedly lower than the rest, while the nine are arranged in two sets, one shorter than the other (Fig. 2). The ovary has a projection towards the base which enters the nectary of the

calyx, and supplies the honey; the stigma is two-lobed, the lower lobe being decidedly smaller (Fig. 3). There is a decided variation in the length of the style, but I was unable to deduce any dimorphic arrangement from what I saw. Long-tongued bees visit the flower, and the case seems one of synacmy, the outer stamens, however, maturing first, and the next in order.—*Aug. F. Foerste, Granville, Ohio.*

THE INTERNAL CAMBIUM RING IN GELSEMIUM SEMPERVIRENS.—Dr. J. T. Rothrock, at the meeting of the Botanical Section of the Academy of Natural Sciences of Philadelphia, held February 9, 1885, called attention to the internal cambium ring in the stem of *Gelsemium sempervirens*. It might well be designated as the inner cambium. His attention was attracted by the fact that in a *stem* of three-eighths of an inch diameter, the pith was actually less in diameter than in a *twig* of a quarter the size of the *stem*. Microscopic examination showed that in the larger stem there were ordinarily four or more points, at which a well-defined swelling curved inward from the circumference of what should have been the pith-cavity. These swellings resolved themselves when closely examined into:

1. Toward the center an imperfectly defined membrane, resembling cuticle, which was not always present.

2. One or more rows of large cells like the parenchyma we find under the epidermal layer.

3. Several poorly defined layers of smaller cells, such as often mark the limits of growth in bark.

4. The frequent presence of bast fibers or of sclerenchyma cells.

5. An evident layer of thin-walled, square cells, closely resembling, though somewhat smaller than those of the external cambium. They showed signs of division, which indicated that they were still a living tissue.

These facts explained at once why the pith was constantly being encroached upon until it at length almost disappeared. The medullary rays dipped down through, and widened out, in this inner cambium, *inwardly*, just as they did *outwardly*, in the usual form of cambium layer. He also remarked that bast fibers had long been known to exist in the pith of *Tecoma radicans*, and in this case something like an inner cambium would be found, though it is more obscure. *Sambucus canadensis* also exhibited in the very large stems a smaller pith than in those of moderate size. In this there was nothing comparable to the inner cambium. He also remarked that for the past two winters his attention had been called to the presence of considerable quantities of chlorophyll in the pith of *Lycium vulgare*. This was not confined to the smallest stems, but was found also in those of over a quarter of an inch in diameter, and where of course a considerable belt of

hard wood was found between the pith and the outer zone where chlorophyll is expected. It was also observed in Lycium that the chlorophyll was not in the form of bodies, but diffused in character, as it is said to be in some infusorians. In Lycium the cells of the pith showed, in winter, abundance of protoplasm which had the nucleus on one side and very striking bands extending thence across the cell to the further side.—*Proc. A. N. S. Phila.*

STRASBURGER'S BOTANISCHE PRACTICUM.—About a year ago this book appeared in Germany, where it has received many favorable notices, as an excellent work for the laboratory student. The book is so valuable that it must soon be translated, but in the meantime we may well give an outline of what it contains. After an introductory chapter devoted to the microscope, various kinds of apparatus, reagents, staining fluids, etc., etc., the work is divided into thirty-four "tasks," in which particular subjects are taken up. The aim of the author is to train the student at once in microscopy and botany, rightly believing that the art named can be best learned in its application to the science of plants. As far as possible the plants selected are common and easily obtainable ones. The illustrations, of which there are 182, are all new, and are made especially for this work.

The general sequence of subjects is as follows: Starch, aleurone, protoplasm, chlorophyll and other coloring matters; crystals; anatomy of the root of sugar-beet; fruit of pear; epidermis and stomata of Iris, Tradescantia and other plants; hairs of various plants; fibro-vascular bundles of Indian corn, oats, palm, Ranunculus, Aristolochia, etc., etc.; secondary wood, anatomy of stems of Scotch pine, linden, ivy, locust (Robinia), pumpkin, etc., etc., running through twenty "tasks" or chapters. A couple of chapters are devoted to the structure and reproduction of mosses, five to the fungi and algæ, one to the reproduction of pteridophytes, another to that of conifers, and five to that of phanerogams proper.

A smaller edition has appeared in Europe, but this we have not yet seen. We trust that a translation of either the larger or the smaller work will be placed before the English-speaking students of this country. There is certainly room for such a book here.—*Charles E. Bessey.*

THE PAMPAS.—In answer to the statement of Professor Asa Gray, following Darwin and Ball, that the pampas of South America are treeless because the only country from which trees could be derived could not supply species suitable to the soil and climate, Mr. Edwin Clark puts forward, in a letter to *Nature*, what he, from long residence and observation, believes to be a more probable cause or series of causes. From the absence of rivers or water storage, periodical droughts (siccos) occur in the

summer, and at such seasons the droves of horses and cattle and the numerous aboriginal wild rodents destroy every vestige of vegetation in their efforts to live, the cattle even tearing out the roots of the pampas grass. The existence of an unprotected tree is impossible. Nothing survives save thistles, some grasses and clovers, a few poisonous plants, thorny dwarf acacias and wiry rushes. The extensive introduction of European plants has only added to the flora of the pampas a few species, such as two thistles that are unassailable by cattle. Yet the soil is fertile and trees grow luxuriantly wherever they are protected.

Botanical Notes.—The odd tree known to the Mexicans by the name of Ocotilla, and to botanists as *Fouquieria splendens*, a native of the Rio Grande plateau region, has been made the subject of chemical studies by Miss Helen C. De S. Abbot, of the Philadelphia College of Pharmacy, the results of which have lately been published in an eight page pamphlet. A new vegetable wax was discovered in the bark, to which the name of Ocotilla wax was given.——Dr. Farlow's paper on the Synchitria of the United States, in the March *Botanical Gazette* is of unusual interest. It contains descriptions of all the species known to exist in the United States, ten in all.——The Botanic garden of Buitenzorg, Java, founded in 1817, consists of ninety-one and a half acres, and contains more than nine thousand species of plants, each represented by two specimens. Connected with the garden is a botanical museum, containing the herbarium, a collection of vegetable products, and the library, with facilities for drawing and photography. All this is in far-off Java! When may we hope for that kind and amount of state help in this country which will enable our botanists to begin the making of botanic gardens worthy of the name?——As showing the tendency in our best universities we note that, according to an item in the *Gardeners' Monthly*, the University of Michigan "has established a chair of forestry in connection with its other branches of education."—— The University of Nebraska has made an appropriation of five thousand dollars for procuring apparatus and collections for its department of botany.

ENTOMOLOGY.

Reproduction in the Honey-bee.—At a late meeting of the Royal Microscopical Society, Mr. Cheshire exhibited and explained four preparations—three of spermatozoa and one of the muscles of the valve of the receptaculum seminis of the queen bee, which he had recently succeeded in dissecting, and of which he gave an interpretation at a previous meeting. The muscles were shown under polarized light with the prisms crossed, so that two sphincters which overlap, and the fibers of which cross, can be dissected. One resolves the polarized beam completely, while

the other gives no twist to the plane of polarization, and so remains invisible; but by rotating the stage plate the latter muscle shines out brightly as the former retires into darkness. Mr. Cheshire finds this method of studying muscular layers in insects of great service. The spermatozoa from the queen bee were exhibited in a dense bundle containing hundreds of thousands of individuals arranged parallel in a tortuous line, and it is in this way that they are packed in the spermatheca, which, in a recently fertilized queen, will contain from four to ten millions of them. The second preparation—an extremely beautiful and curious one—presented the spermatozoa (in this case taken from the vesicula seminalis of the drone) in separation from one another. The contents of the "vesicula" being diluted with water upon a warm slide, the spermatozoa, by their spontaneous movements, spread themselves in a perfectly regular and compact single layer, each individual twisting itself finally into a regular figure like two 8's, surrounded by a larger O. Each spermatozoön is not less than 250μ in length. Spermatozoa from the queen wasp was the third object. These spermatozoa, about 200μ in length, are extremely thin, and carry no visible head, although the ends are not equal in diameter. They take the same typical form as those of the bee. Mr. Cheshire states that for insect spermatozoa he prefers Spiller's purple as a stain. In his remarks he called attention to the curious fact that if a drone larva be introduced into a queen's cell while she is passing through the chrysalis condition, the artificial aperture by which the drone larva was introduced, being afterwards carefully closed, the queen will hatch out already fertilized and capable of at once laying eggs which will produce workers. This remarkable fact seems to open up the way for quite a new method of investigating a certain class of insect phenomena.—*English Mechanic.*

Life-histories of Mites.—At a late meeting of the Royal Microscopical Society, Mr. A. D. Michael read a paper "On the Life-histories of some little-known Tyroglyphidæ." In 1873 Riley published a report on the ravages of the apple-bark louse (*Aspidiotus conchiformis*), and described an acarus which was supposed to destroy that pest, and which he thought might be the *Acarus mali* of Shimer. Riley only describes the female. Mr. Michael has found the acarus in England under the bark of reeds, destroying the reeds, not feeding on any insect, and concludes that it is probably a feeder on various kinds of bark, not on animal life. He has traced the whole life history. The male (previously unknown) presents the exceptional features possessed by the male of *Tyroglyphus carpio*, discovered by Kramer in 1881, and the hypopial nymph has been figured by Canestrini and Fanzago in 1877 under the name of "parasite of an Oribata," but without explanation. Mr. Michael finds in the life history of this

hypopus a confirmation of his views that the hypopial stage is not caused by exceptional adverse circumstances, as Mégnin supposes; but is an ordinary provision of nature to insure the distribution of the species, which it is intended to call *Tyroglyphus corticalis*. Mr. Michael also called attention to the prevalence of *Rhizoglyphus robini* on Dutch bulbs imported into England in 1884, and to the destructive nature of that species, and the damage it did to hyacinth, dahlia and Eucharis bulbs, &c., and recommended that imported bulbs should be carefully examined. —*English Mechanic.*

Firefly Light.—MM. Aubert and R. Dubois have recently made a number of interesting observations on the light emitted by "pyrophores," or fire-bearing insects of the family Elateres, genus Pyrophorus. These pyrophores have three luminous organs, one situated at the ventral part, and two at the superior part of the prothorax. The last are always visible, and were submitted to the tests. The light was produced by rubbing the insect with a light brush, and was examined by means of an ordinary spectroscope with a prism of very refrangible glass and a micrometer. The spectrum was very fine, continuous, and showing neither brilliant nor dark rays. This peculiarity has already been pointed out by Pasteur and Gernez, who studied the light from a pyrophore belonging to the late Abbé Moigno, editor of *Les Mondes*. The spectrum occupied about seventy-five divisions of the micrometer, and extended on the red side to the middle of the interval which separates the rays A and B of the solar spectrum, and on the blue side a little beyond the ray E. When the intensity of the light varied, its composition changed in a remarkable manner. When the brightness diminished the red and orange disappeared entirely, and the spectrum consists of green, and a little blue and yellow. The green rays lasted longest. The contrary took place when the light grew in brightness, the green appearing first and spectrum extending a little on the blue and a great deal on the red side. The least refrangible rays are, therefore, emitted last. No other luminous source known appears to behave in like manner. The only case which bears a resemblance is that of sulphate of strontium becoming phosphorescent under the action of light at a glowing temperature. As the temperature rises, rays less and less refrangible appear in the spectrum, but at the same time, as Edmond Becquerel has shown, the less refrangible rays disappear. When the light of the organ begins to appear, the central and forward part only of the organ is luminous. It is only when the light is very bright that the periphery of the organ is luminous, and then the red rays are visible. The light was found to give photographic images on a gelatino-bromide plate; the insect being two centimeters from the plate, and the time of exposure reduced from an hour to five minutes. The photographs show that the light of the pyrophore

is capable of producing intense chemical effects, if the smallness of the quantity emitted be taken into account. The light also determines the phosphoresence of sulphate of calcium, after an exposure of five minutes; and eosine and azotate of uranium are rendered fluorescent by it.

The foregoing is taken from an exchange; the first spectroscopic research in firefly light was those of Professor C. A. Young, published in this magazine, vol. III, p. 615, 1870.

USE OF AN ADHESIVE FLUID IN JUMPING INSECTS.—Dr. Dewitz has described the use of a sticky fluid by insects in jumping. A Cicada in a closed glass tube is able to jump from the bottom on to the cover, and from one vertical side to the other, turning in the air; the contingency of having to jump on to vertical surfaces, or the under side of horizontal surfaces, occurs also in Nature—viz., in the case of stems and leaves, which are, moreover, smooth, so that claws are ineffectual to support the insect, and sucking-disks would probably not act with sufficient rapidity. Now, the leaping spiders possess a well-developed pedal adhesive apparatus, by the aid of which they can remain attached to the surfaces on which they alight; the glands which secrete the liquid open all over the balls of the feet, and are especially numerous at their bases.

ENTOMOLOGICAL NOTES.—We glean from the *Zoölogical Record* for 1883, such notes as are of general interest.——Klemensiewicz publishes detailed observations on the glands of the skin of caterpillars.——As the respiration of insects, says Langendorf, depends on abdominal movements, it may continue after the removal of the head. The number of respirations is increased by heat. Tobacco-smoke and chloroform lead to intermittent, but more or less rhythmical respiration for a time. The head and prothorax may be removed, and the respiration will continue; and if the abdomen of a dragon-fly is cut to pieces, respiration will continue in them, thus showing that each abdominal segment possesses its own respiratory center.——Osborne finds that in the European *Zaræa fasciata*, the color of the cocoon depends on the food, larvæ fed on strawberry forming dark-brown resinous cocoons, and those fed on honeysuckle forming pale-greenish cocoons. In this saw-fly parthenogenesis is the rule.——H. Müller states that bees in unaccustomed localities are timid, and find honey with difficulty, but rapidly become accustomed to their surroundings, especially under the guidance of comrades. Different bees exhibit a preference for certain flowers over others, but very brilliantly colored flowers are less attractive than those of more subdued colors. The results of a long series of experiments are summed up with the conclusion that blue or violet are the most attractive colors, and bright yellow the least so.——At the suggestion of Darwin, Fabre undertook a series of experiments to

test the power of bees to return to their nests when carried to a distance; a considerable number returned safely.——*Ammophila hirsuta*, says Fabre, searches for the larvæ of *Agrotis segetum*, which are detected under the surface of the ground by some apparently unknown sense. The larva is carefully paralyzed in every segment before being buried, which leads the author to conclude that the Ammophila originally preyed on insects more easily paralyzed, and as it gradually attacked larger insects, its instincts enlarged, and became hereditary.——W. F. Kirby finds that hybrids between *Smerinthus ocllatus* and *populi* usually show traces of hermaphroditism, which seems to indicate that hermaphroditism is encouraged by hybridity, and that the usual sterility of hybrids may be due to this cause.

ZOOLOGY.

ANOTHER VORTICELLA WITH TWO CONTRACTILE VESICLES.—In the NATURALIST for August, 1884, the writer described a new infusorian belonging to the genus Vorticella, under the name *Vorticella lockwoodii*, one of the peculiarities of which was the possession of two contractile vesicles, that being the first recorded instance of the occurrence of more than a single pulsating vacuole in any of the numerous species. Now, however, I desire to state that a similar arrangement obtains in the well-known *Vorticella monilata* Tatem, a species originally discovered in English waters, and by no means uncommon on the continent of Europe or in this country. It therefore seems somewhat surprising that the presence of the two vesicles in this widely distributed form should have hitherto eluded observation. The species occurs in this locality in some profusion, a colony recently taken attached to Myriophyllum from my aquarium being formed, by actual count, of two hundred individuals, another of eighty-three, smaller collections not being rare. With these I have been able to positively determine and demonstrate to a friend the presence of two contractile vesicles which, when the vorticella is in the proper position, are distinctly visible without a change of focus. The fact of their presence is of interest since it is a point in the anatomy of these minute creatures not previously noted.—*Dr. Alfred C. Stokes, Trenton, N. J.*

CUVIERIAN ORGANS OF THE COTTON-SPINNER.— Professor F. Jeffrey Bell gives a technical account of this almost unknown British Holothurian, which is of interest as being the only true —that is, aspidochirotous (or with shield-shaped tentacles)— member of the class which is known to occur in British seas. The organ of most importance is that which produces the sticky secretion from which these animals have obtained their name, and which makes them objects of much dread to the Cornish fishermen. The producing or cuvierian organs are described as forming a solid mass which occupies a large portion of the body-

cavity, and which is made up of a number of separate tubes; a small coiled portion was found lying in the cloaca as if ready for ejection. A small piece of a tube, measuring only 2.5$^{mm.}$ was found even after twenty years' immersion in spirit, to be capable of extension to twelve times its own length; while, when treated with water, the attenuated thread swells up to seven times its own breadth. "We can thus understand that an animal at whom these threads are thrown should, as it attempts to escape, lengthen the threads which, at the same time, coming into contact with the water, would be swollen out transversely as they were extended longitudinally." Professor Bell thinks that the observations confirm the view of Semper as to the protective or offensive character of these organs, which, by Jäger and most later anatomists, have been thought to be renal in function.

In a subsequent note Professor Bell states that six threads, any one of which was only barely visible, were capable of supporting a weight of nearly a thousand grains; and quotes a letter from a correspondent to say that the black holothurians near Porto-Fino, emit a tangled mass of white threads so sticky and in such quantity that it was difficult to free the hands from them.—*Journal of the Royal Microscopical Society, December, 1884.*

Earth-Worms.—An interesting paper on the habits of earth-worms in New Zealand is contributed to the New Zealand Institute by Mr. A. T. Urquhart. The species are not named, but with such wonderful opportunities as Mr. Urquhart possesses for making a collection of these, may we hope that, in addition to his following out his observations as to their habits, he will also advance science by making a careful collection of the forms and placing them in the hands of some of the able naturalists of the Auckland Institute for description? It will be remembered that Darwin assumes that in old pastures there may be 26,886 worms per acre, and that Hensen gives 53,767 worms per acre for garden ground and about half that number in cornfields. Mr. Urquhart gives, as the result of his investigations of an acre of pasture land near Auckland, the large number of 348,480 worms as found therein. It being suggested to him that in his selection of the spots for examination he may have unconsciously selected the richest, the experiment was again tried in a field seventeen years in grass. A piece was laid out into squares of 120 feet, and a square foot of soil was taken out of each corner; worms hanging to the side walls of the holes were not counted, and in one hole, where the return of worms was a blank, the walls were crowded with worms. As a result there was an average of eighteen worms per square foot, or 784,080 per acre. Although this average is very striking when compared with that of Hensen, it is worthy of note that the difference between the actual weight of the worms is not so marked. According to Hensen, his average of 53,767

worms would weigh 356 pounds, while Mr. Urquhart finds that the average weight of the number found by him came to 612 pounds 9 ounces.—*Scientific American.*

Deep-sea Explorations of Last Summer by the U. S. Fish Commission.—Professor Verrill reports that the zoölogical results this year were of great interest. Many additions to the fauna of great depths were made, and a large proportion of them are undescribed forms. Some of the fishes were of great interest. Huge spiny spider-crabs (*Lithodes agassizii*) over three feet across were taken in 1000 to 1230 fathoms, and another very large crab (Geryon) occurred in great abundance in 500 to 1000 fathoms, while in 2574 fathoms a large and strong crab-like creature (Munidopsis) was taken. Many curious shrimp, some of them of large size and brightly colored, and often with perfect eyes, occurred in most of the deepest dredgings. Several very interesting new forms of star-fishes, ophiurans, and holothurians were dredged, some of them in large quantities, even in the deepest localities. Several interesting new forms of corals, gorgonians, sea-pens, and allied forms also occurred. Numerous specimens of huge sea-urchins with flexible shells (*Phormosoma uranus*) were obtained from several different stations, in 600 to 1100 fathoms. Some of these are about ten inches broad. One sea-urchin (Aspidodiadema), not before observed north of the West Indies, was taken in 991 fathoms. Most of the deep-sea star-fishes belong to the genus Archaster and other closely related genera. Some of these, like *A. agassizii* and *A. grandis*, were taken in large numbers, several hundreds in a single haul. And the same often happens with several of the ophiurans and sea-urchins. One interesting stalked crinoid (Rhizocrinus) was obtained in 2021 fathoms.

Many additions were made to the Mollusca. In July, Professor Verrill published a general list of all the deep-water Mollusca taken in the gulf stream region off this coast, up to the end of 1883. That list included 338 deep-water species and 42 that inhabit the surface waters. This year about 25 deep-sea species and about 8 from the surface were added to the list, making the total number over 400 species. Among the new forms discovered this year are four or five species of cephalopods, some of them very remarkable, and representing new genera. There were some very interesting new shells, some of them of good size and well developed, from below 2000 fathoms. Most of the larger and finer ones from the very deep waters belong to the Pleurotoma group, but some large species are allied to Sipho (or Fusus) and to Dolium. Numerous specimens of three rare species of brachiopods were also dredged from below 1000 fathoms. These are *Discina atlantica*, *Waldheimia cranium* and *Atretia gnomon*. The latter has not been known before from this side of the Atlantic.

Anatomy of a Catfish.—Professor R. Ramsay Wright, with Professor J. P. McMurrich, A. B. McCallum and T. McKenzie,

have published in the Proceedings of the Canadian Institute of Toronto "Contributions to the anatomy of Amiurus." The papers serve as a contribution to the morphology of a comparatively little known family of fishes, and will also be of use to teachers of comparative anatomy. The skin and cutaneous sense-organs as well as the nervous system and sense-organs are described and figured by Professor Wright; the osteology and myology by Professor McMurrich, the alimentary canal, liver, pancreas and air-bladder by Mr. McCallum, which Mr. McKenzie has worked out the blood-vascular system, ductless glands and urogenital system. The work comprises 206 pages, and is illustrated by eight folding heliotypic plates.

Professor Wright describes certain structures which are apparently comparable to the nerve-sacs of the ganoids; he also discusses the relationship between the air-bladder and the auditory labyrinth. The work is another of the monographic essays now appearing from time to time, and affords the modern student aids and facilities such as were entirely unknown a generation ago.

THE SPIRACLES OF AMIA AND LEPIDOSTEUS.—My note on this subject in the February NATURALIST requires modification, in so far as what I took to be the oral aperture of the spiracle in Amia is really the aperture of a canal in which the pseudobranchia lies, and into which the spiracular cleft opens further forwards. The pseudobranchia of Amia is homologous with the upper (non-respiratory) part of the opercular gill in Lepidosteus; both are innervated by the anterior branch of the glossopharyngeus, but the pseudobranchia of Lepidosteus is free, while that of Amia is concealed in what may be termed a pseudobranchial canal. The singular continuity of this canal with the spiracular cleft induced me to believe that I had found evidence to justify Dohrn's criticism of Gegenbaur's views as to the homology of the pseudobranchia of the Teleosts, but I am now convinced that the condition of the parts in Amia proves Gegenbaur's position to be correct.—*R. Ramsay Wright, University College, Toronto, February 10, 1885.*

BIRDS OUT OF SEASON—A TRAGEDY.—Our winter so far has been one of unusual severity, such low temperatures as — 20° to — 35° having prevailed quite often. Whole weeks have passed in which the mercury has not risen above zero! But during all this time, until the afternoon of the 18th instant—"a chewink" (*Pipilo erythrophthalmus*) has lived about my orchard and barnyard. I am unaccustomed to seeing much of this species, except in early spring, upon their return from the South. It breeds here, but is a very quiet bird through the summer and autumn—at least, it has only been upon rare occasions that I have seen it. But soon after winter set in I saw the one in question in the barnyard, where he seemed to be feeding upon some scattered grain. Later I found him one very cold afternoon in a "straw-built shed,"

where I easily caught him. After looking him over, and comparing him with Dr. Brewer's lucid description, I let him go. Catching him did not seem to have caused him any alarm or discomfort, for he remained about the premises quite as tame and sprightly as usual.

In addition to the chewink, a robin has also been a frequent visitant here. We saw him some days ago, and again last night, when the mercury was down to — 20°. But it is not at all unusual for robins to be here in winter, though I do not remember having ever seen more than one at a time.

On the afternoon of the 18th instant, our dear little chewink, which we had come to regard with great solicitude, met with a very sad fate. Going into the barnyard, I saw a couple of birds dart down to the side of a hay-stack. One was a jay, and at the first glance I thought the other was also. But in an instant it occurred to me that the jay was killing the under bird. I sprang forward hoping to rescue it. I was just an instant too late—for the jay picked up the bird, now dead, and flew away with it! The load was a heavy one, and as the cannibal flew off across a ravine, it bore him down almost to the ground. The quick glimpse I had of the glossy black head and back, the chestnut sides, and the white under parts, showed that it was our poor chewink—whose fortitude in braving our terrible winter had met with a sad requital. I have always defended the blue jays, though I know they are addicted to a great deal of "crookedness" in their treatment of other species of birds; but this incident has quite disgusted me with them.—*Charles Aldrich, Webster City, Iowa, Jan. 29, 1885.*

How far does the Jerboa Jump?—On page 71, of his most entaining volume, A Naturalist's Rambles about Home, Dr. Charles C. Abbott, in speaking of the pretty "kangaroo or jumping-mouse," quotes Godman to the effect that it leaps "five or six feet at every spring;" but expresses a doubt on the subject. He says: "Without the means of determining this point, I should judge that one-half that distance was more nearly correct." While living at my old boyhood home, in Cattaraugus county, New York—forty years ago—I used occasionally to see one of these very interesting little animals. The first one I ever saw was in the meadow, where I was raking hay with a common, old-fashioned hand-rake. The mouse made a sudden spring, and I "went for it" with my rake. After chasing it two or three rods I hit it with the rake-head and killed it. My recollection is very distinct, that it "leaped at least five or six feet," at the start —though it appeared to tire out very quickly, reducing the length of its leaps to not more than two or three feet. I conclude that both writers have recalled their observations correctly, and that the condition of the animal, possibly also its age, may determine its jumping capacity. I remember that in this, as in other

instances, each jump was made in a different direction from the last, so that it was a matter of some difficulty to pursue the little creature! I was exceedingly interested in this first capture—never having seen or heard of one before. One of our farm hands told me that it was a "kangaroo mouse." After that I saw one occasionally, and my recollection is very clear that Godman does not overstate its ability to jump. I have never seen or heard of one in this region.—*Charles Aldrich, Webster City, Iowa, March 5, 1885.*

EMBRYOLOGY.[1]

ON THE PROBABLE ORIGIN, HOMOLOGIES AND DEVELOPMENT OF THE FLUKES OF CETACEANS AND SIRENIANS.—We have seen that the development of the Physoclist fishes (AM. NATURALIST, 1885, pp. 315–317), shows that the translocation of the pelvic fins forward is accomplished in some forms in about twenty-four to forty-eight hours, to a position more or less in advance of the pectoral. If a limb-fold can be translocated forwards in a vertebrate embryo from its archaic site, there is no reason to doubt that under certain conditions it might be translocated in the other direction or backwards. A process of translocation of the distal end of the pelvic limbs seems to have occurred in the cetaceans, as a consequence of which the pes has acquired a new position far to the rear of that which it occupies in normal mammals, and this seems to have been accompanied by processes of atrophy in some directions and hypertrophy in others.

The researches of Struthers, Flower, Reinhardt, Eschricht, Kaup, Lepsius, Howes and Wilder, leave no doubt as to the fact that the different rudimentary structures which these anatomists have detected, unequivocally point to the conclusion that, the cetaceans and sirenians have descended from Mammalia which possessed more or less perfectly developed ambulatory limbs, which fitted them at least for an amphibious or partially terrestrial existence. This conclusion is, I believe, generally accepted by recent authorities.

All recent writers, amongst which may be named Flower, Huxley, Owen, Claus and Parker, unequivocally declare that the hind-limbs of the whales and sirenians have been so completely suppressed, that no rudiments or vestiges of any kind have remained to indicate outwardly that these creatures ever possessed such appendages, the evidence that they did once possess hind-limbs resting for them rather upon the presence of a rudimentary pelvis with much reduced limb-bones in a few forms of Balænoidea and in Halitherium.

From this view the writer must dissent, having independently arrived at conclusions in reference to the homology of the flukes

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

very similar to those published by Professor Gill[1] in 1882, who regards these characteristic structures as having been derived from greatly hypertrophied integuments of hind-limbs analogous to such as are developed, for instance, to the hind-limbs of the eared seals, while the osseous elements have been inversely atrophied, pulled forwards, and reduced to supports for muscles connected with the organs of generation. It may, I think, be regarded as a fact that there is no evidence to show that development does not attempt to recapitulate in a disguised form, in the cetacean fœtus, the outgrowth of the hind-limb as seen in a normal mammalian embryo.

In the mammal the pectoral limb is the first to appear, the pelvic appearing last. If the flukes be regarded as the outward vestiges of hind-limbs or pedes, then will the embryos of cetaceans and sirenians conform to this law presiding over the order of appearance of the limbs, which, so far as I am aware, is regnant without exception within the limits of the vertebrate class. The dorsal fin with which the flukes have so often been mistakenly compared, is not present in all cetaceans; is absent in all sirenians; is not constant in position in different genera of the former; is sometimes a mere carina, dorsal ridge or hump; its vascular and nerve supply is different from that of the flukes; it develops after the latter, showing that it is a later acquirement; it has absolutely no connection with muscles directly or indirectly by tendons as have the flukes, so that I regard the comparison of the dorsal fin, which is a mere dermal fold, with the flukes, as expressing a mistaken apprehension of anatomical homologies, and not justified in the face of the fact that the flukes are never absent, and always appear laterally or serially in the position of a hind limb-fold, though backwardly displaced. It must, however, be stated that I distinctly disavow the affirmation that the flukes are homologous with more than the pedes of normal forms. The older views which intimated that the flukes were the representatives of limbs or of feet, it is not worth while to discuss, as these writers did not possess the data upon which to base any reasons for their opinions, which seem to have been in the main intuitional.

The hypothesis which is offered to account for the flukes as the distal vestiges of limbs rests upon the following arguments:—1. The mode of outgrowth of the flukes in the embryo, prior to the dorsal fin, at the end of the sides of the tail, at first as a pair of low rounded lobes or folds of skin, containing mesoblast, which become gradually falcate, and which expand posteriorly so as to leave a notch over the end of the tail between their inner edges. The hind margin of the flukes answering to the terminal border of the pes or the ends of the suppressed toes or the integuments extending beyond them, and their anterior margin to the outer

[1] Scientific and popular views of nature contrasted. A lecture delivered in the National Museum, March 11th, 1882. Pp. 10–11. Washington, Judd & Detweiler.

digital border. 2. The existence of a small median papilla, according to Wilder, at the extreme end and under side of the tail of the fœtus of the manatee, representing apparently the last vestige of an exserted tail extending beyond and behind the fluke folds of this type, in which the flukes are in fact rudimentary. 3. The fact that the osseous elements of the limb have atrophied exactly in the reverse order in which they appear in the embryo, or from without inwards, that is, from behind forwards in cetaceans and sirenians, because in both, the hind-limbs have been rotated or extended permanently backwards distad of the knee-joint. 4. The structure of the embryonic fluke-folds or diverticula filled with mesoblast comparable to that found in the limb-folds of other vertebrate embryos, these limb-buds representing structures which have survived translocation and made an attempt to imperfectly recapitulate the development of part of the limb.

The above headings present the embryological argument. The other data are anatomical and are mainly based on a comparison of the pinniped and cetacean types. Admitted that the cetaceans are descended from land forms, we would naturally look to types of amphibious habits and poorly adapted for progression upon land to furnish the first indications of modifications which have been carried to an extreme degree in the former. Traces of the beginnings of such modifications we actually find in pinnipeds.

In the pinnipeds, the hind limbs, from the knees, have been rotated backward and included by a continuation of the integument which invests the body together with the tail, leaving only the last two or three short caudal vertebræ exserted or projecting into a caudal integumentary pocket, lying between the distal parts of the backwardly extended limbs. This process of inclusion, if carried to an extreme stage, would finally cause the whole of the tail to be lost to sight outwardly, leaving only the metapodial and phalangeal parts free. As a result of this arrangement in the pinnipeds certain muscular insertions of the limb muscles have been moved backwards, and the hyposkeletal flexors of the trunk have become more powerful; the abdominal muscles extending over the knees have restricted the movements of the femur. As a further result of this restricted movement the pelvis has begun to degenerate, the symphysis pubis become less defined, and the femur shortened. We are therefore, I submit, the actual witnesses of a process in the pinnipeds which if carried still further would bring about the condition now found in living cetaceans. The pedes in pinnipeds have been hypertrophied together with the metapodial and phalangeal elements, but are not the fingers also lengthened and their joints multiplied in the cetacean manus? In the Plesiosauri, Ichthyosauri and Lyrifera or true fishes, the same thing has occurred, namely hypertrophy and lengthening or increase of limb-elements comparable to phalanges, with a corresponding shortening of the proximal bones in contact with

the shoulder and hip-girdles. Manifestly the pes of a form like Megaptera, if mobile, would require a system of phalanges as powerful as those in the manus, but the pes is not mobile in any cetacean, on its own base, as is the fore-limb, but is rigidly affixed to the sides of the end of the tail and incapable of independent movement, hence the atrophy of its bones. The only evidence remaining to indicate that the pedes or flukes of cetaceans were once possessed of well-developed phalanges, is the distribution of the dorsal and ventral interdigital arteries, the arrangement of these in fact indicating that there was a great inequality in the length of the digits of the pes, the same as we now see in the manus, thus leading to the conclusion that the foot-structure of the ancestral or protocetacean type was so far different from that of the pinnipeds.

The next step in the process would be the atrophy of the limb-bones and muscles, which, on account of still greater restriction of their movements, would become useless, leaving the integuments of the feet as the flukes on either side of the end of the tail, which, with the total abandonment of the land by the animal, would become stronger and its centra greatly developed, carrying the pedal folds or flukes still farther rearward, and thus increase still more the interval between them and the remnants of the pelvis. At the same time, the muscles of the tail would become greatly developed, so that in the cetaceans we actually have the spectacle of an animal type which has descended from a land form with a degenerate tail again acquiring a tail of the functional importance of that of a fish, but structurally very dissimilar, especially as regards the arrangement of its muscles, which are not homologous with the muscular somites of a fish's tail. The pes thus becomes the only outwardly apparent part of the hind limb, just as the manus is the principal part exserted in the fore-limbs of cetaceans, where some of the muscular insertions have also been shoved outward or into a more distal and effective position. The inclusion of the end of the tail of cetaceans between the flukes has also differentiated the caudal vertebræ of the latter into two distinct and well-marked series, so that the centra, as respects their vertical diameters, do not taper from the sacral region backward, as in other mammals, but only from in front of the flukes backward.

The arrangement of the vessels of the manus and flukes is somewhat similar, but totally unlike that of the vessels entering the dorsal fin, which has only a median system, whereas the flukes have about ten dorsal and as many plantar vessels just under the integument, the prolonged fourth of these, reckoning from the anterior border of the fluke, being the analogue of the prolonged interdigital artery lying between the second and third digits of the manus, and which supplies the end of the flipper with blood, just as the outer two-thirds of the flukes are supplied by the prolonged fourth dorsal and ventral pair spoken of above.

Finally, it may be said that the rudimentary tibia, when present, is directed backward in the cetaceans just as in pinnipeds, showing that if it were fully developed and prolonged it would carry the pedes far behind a vertical line drawn through the hip-joint. There is also other evidence that the inclusion of the hind limbs in the whales has occurred in much the same way as in pinnipeds, for example, the femora are adducted to a remarkable degree in Balæna, according to Struthers, showing that the encroachment of other parts must have been the principal cause of such adduction. The femora of Halitherium seem also to have been directed backward toward the flukes, according to the figures given by Lepsius.

The translocation of the pedes of cetaceans has been accomplished through an extended phyletic series and was not sudden or partially saltatory as in the case of the pelvic limbs of embryo physoclists. The translocation in the first case was due to the backward extension of the limb, outwardly carrying only the pes away from its original place, in the latter the whole limb is shifted together with the girdle. In cetaceans there has been little or no shifting of the pelvic girdle, its detachment from the vertebral column being due to the atrophy of the ilium. The extension backwards of the limbs and pedes parallel with the caudal portion of the vertebral column, obviously began in an amphibious mammalian type and has thus *gradually* brought the pedes to their present position, where they appear ontogenetically; heredity, through immediate ancestry, here, as in many other cases, greatly marring the phylogenetic record. This gradual shifting, according to the method described, completely does away with the difficulty suggested by Flower as to the helplessness of the animals during the transfer, which really began in forms already to a great extent helpless on land but certainly not in the water.

The foregoing gives the principal anatomical and embryological grounds for regarding the flukes of Cetacea as the representatives of pedes translocated backward by rotation and extension of the limb rearward into a position parallel with the tail by the process of inclusion as described above, but as it is impossible to consider the evidence in favor of this conclusion in detail in this brief abstract, those interested are referred to my illustrated memoir on the subject almost ready for publication by the U. S. Fish Commission.—*John A. Ryder.*

PSYCHOLOGY.

Intelligence of the Limpet.—By far the larger number of limpets "roost" upon rocks whose only covering consists of minute green algæ and millepores, together with numerous acorn barnacles. These last are seen to be of very unequal degrees of "cleanness," some being covered with vegetable growth, others quite white and bare. Those immediately surrounding a limpet or group

of limpets are invariably free from algæ. As might have been anticipated, Patella is the cause of this freedom. At low tide any one on the lookout can hear a quick, regular rasping sound in all directions, and see numerous limpets slowly crawling about. Scrutiny of any particular individual shows that the rasping noise is caused by strokes of the radula, which speedily scrapes away the incrusting algæ. Whilst "on the feed" a limpet moves steadily on, pretty much in a straight line, and continually sweeps its elongated snout from side to side, feeling out probably suitable patches whereon to graze. When such a one is discovered, it is gradually licked quite clean. If the patch happens to be the surface of a moderate-sized barnacle, the circular lip is completely spread over it, almost tempting one to believe that the crustacean is about to be "sawn out." Such, however, is not the case, "house-cleaning" being the sole end in view. Indeed, limpets are often serviceable to one another by thus clearing away esculents growing upon their shells. To secure a dinner, a good deal of licking is requisite, and perhaps this habit may help to account for the inordinate length of the tongue-ribbon. Certainly, it must be used up at a very great rate.

But this is not the only, though I believe the chief way in which the limpet feeds. Those individuals which live near large seaweeds, such as Fucus, feed extensively upon them, as their gnawed condition testifies. I can speak confidently in this matter, having caught more than one limpet in the act. The operation was as follows: The edge of a thick flat part of the thallus was seized by the lip (as a traveler might commence on a colossal sandwhich), and being, I suppose, held firmly by the upper jaw, a semicircular "bite" was gradually excavated by successive scrapes of the radula, the edges of the bite being beveled on the under side. So far as my observations extended, limpets do not feed when covered by water, but always settle down firmly before the rising tide reaches them. The intervals between which any particular limpet feeds seem to be very irregular; but, as a rule, the largest limpets are apparently least fond of long fasts.

In regard to the second point, the locality-sense, great doubt seems to exist in the minds of naturalists as to whether limpets go back to the same place to roost. I believe the question was answered in the affirmative long since by a Mr. King, but, as far as is known to me, he did not publish any details of his observations, and this is my excuse for giving an outline of mine. Following a suggestion of Mr. Murray, I marked a number of limpets with white paint, and made corresponding marks near their "scars" with a view to "keeping my eye on them." As Dr. S. P. Woodward remarks, it seems probable from an *a priori* point of view, that limpets have a settled home, for they occupy scars, often sunk to a considerable depth, which exactly correspond to the outline of the shell. My observations, made on numerous

specimens of various sizes, completely confirm Mr. King's opinion, and the method of marking rendered cases of "mistaken identity" quite out of the question. The greatest distance from its scar at which I noticed a limpet to be, was about three feet; yet this distance, though extremely rough, and covered with barnacles, was retraversed without difficulty. The excursions from the roosting-places were made in any direction where food offered; so there was nothing like beaten tracks formed. But a limpet always returns home before the rising tide reaches it, and invariably roosts with its snout pointing in the same direction. As might be expected, this position is constant only for individuals. As the shape of the scar corresponds exactly with the shape of the shell, comfort, of course, could only be gained, and a firm hold effected by limpets roosting permanently in the same direction on their scars.

The question now arises, what sense is employed by the limpet in finding its way back to its scar? The appreciation of locality displayed is certainly, for so simply-organized an animal, very keen. The sense of sight is, evidently, out of court, for an eye like the limpet's, consisting of no more than a sensitive cup, could do little if any more than distinguish between light of different degrees of intensity. The tentacles seemed at first sight to be extremely likely organs to use for the purpose, and to decide this I excised those of two marked individuals, which were off their scars. One speedily found its way back; the other seemed confused by the operation for several days, but after that time was found on its scar. This shows a remarkable power of memory, unless the scar was found by accident, which is possible, as the individual was near home when the operation was performed.

But even in that case the scar must almost certainly have been *remembered*. Thus the tentacles do not seem to be the means by which home is returned to. The sense of smell then suggested itself, and it occurred to me that one reason why limpets keep on their scars when covered by the water was to prevent the "scent" of the track traversed from being washed off. With a view to determine this the space between a wandering limpet and its scar was carefully washed again and again with sea-water. In spite of this the limpet in question readily found its way back again. Further experiments are, however, needed, on this head, for any ordinary washing would be very ineffective compared with the prolonged soaking the tide would effect in the case of a limpet (like the one just mentioned) living some distance below high-water mark. Still some limpets live so near this last that they are covered but a very short time, and yet these remain on their scars during that time. Hence I think some other motive probably induces them to remain firmly fixed to their scars when under water. Of course they can hold on best when so fixed, and this suggests the most likely reason for the habit, *i.e.*, to avoid

being washed off the rocks by the tide. I am inclined to think that the snout plays some part in helping the limpet to get home, as this organ is extremely sensitive, and certainly plays an important part in discovering suitable food. I intend carrying on more extended observations with a view to the more complete elucidation of this puzzling question in regard to the limpet's locality-sense, but this preliminary notice may possibly be of some interest.—*F. R. Davis, in Nature for Jan. 1, 1885.*

ANTHROPOLOGY.[1]

ELEMENTS OF GENERAL ANTHROPOLOGY.—Without drawing invidious comparisons, it would not be unfair to say that anthropological science is better organized in France than in any other country. The Dictionary of Anthropological Sciences, now going through the press in Paris, is just at this moment followed by a colossal work by Dr. Paul Topinard. The first volume, of 1157 pages, entitled "Eléments d'Anthropologie générale," relates to the history of anthropological investigations and to those special investigations which have been prosecuted upon the human body. The second part of the Anthropologie générale will bring together all the matter furnished by the different branches of the natural history of man, taking into account instructions furnished by accessory sciences, and will make a synthesis of these results, concluding with a discussion of man in time, his origin and his future.

The second volume of the work will be the application of the zoölogic method to the determination of all the types of the human species and of all the races. This will be denominated "Anthropologie spéciale."

Without spending a word in the praise of a work which speaks for itself, we will give our readers a few of the tables not accessible in any text books, but indispensable even to intelligent readers.

The first six chapters are historical, tracing with great minuteness the methods of studying man from Herodotus, Hippocrates, Aristotle and Galen down to the foundation of the Anthropological Society of Paris. The next three chapters, VII, VIII, IX, treat of the methods to employ in anthropological research. The remaining chapters are devoted to the study of the hair, nose, color of hair, eyes and skin, cephalic indices, height, brain-weight, skull-cubage, craniometry, zoölogic characters, æsthetic characters and anthropometry.

In a former number of the NATURALIST we called attention to a fact, often noticed, that the method of the formation of races is in a certain sense antizoölogical. As Professor Flower observes, the methods of the formation of species are necessarily disper-

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

sive, centrifugal. As in the cosmic period heavenly bodies were thrown off by a revolving mass, so have species arisen by that isolation which is necessary to the fixity of hereditable characteristics. There seems to be a growing conviction that the first human stem threw off at least three branches to which the specific law just mentioned applied. But expanding indefinitely the borders of these subspecies, if you like, soon overlapped and set up a concrescent, concurrent movement, resulting in a diversity of races.

Dr. Topinard accepts this tripartite division of humanity, developed by Cuvier and enforced by Flourens and de Quatrefages, but justifies this plan by arguments wholly his own.

Taking the section of the hair or crinal index as a primary classific concept, he gives the table below :

1. Hair straight, section more or less round, scarce on the face and body.	Yellow and red races of Asia and America.
2. Hair nappy or very spiral, section more or less elliptical.	Negro races of Africa and Oceanica.
3. Hair more or less curled or wavy, oval in section.	European races, Australians, Nubians, etc.

The next concept is the nasal index, to which Dr. Topinard attaches great importance. Adding this to the color of the skin we have :

Leptorhines (living) 69 and less	White Races [Leucoid]	Hyperleptorhine		Anglo-Scandinavian (Kymri)
		Leptorhine (non-aquiline)		Celts
		" (aquiline)		Semites
Mesorhines (living) 70 to 81.4	Yellow Races [Xanthoid]	Flat noses	Leptorhine (cranial)	Eskimo
			Mesorhine (cranial)	Yellow races of Asia
		Saliant nose		Red-skins
Platyrhines (living) 82 and above	Black Races [Melanoid]	Well formed nose		African Negroes
		Nose coarse, with enormous alæ	Melanesians and Australians	

The nasal index on the living is the ratio between the length of the nose from the root to the outer insertion of the septum and the width outside of the alæ.

The subject of color is further discussed in its relation to the eyes and hair and the races grouped as below :

Eyes, color.
1. Black and blackish, diff. shades (Top. 317).
2. Green.
3. Hazel.
4. Blue and clear of diff. shades, includ. clear gray.

Hair, color.
1. Absolutely black.
2. Dark brown.
3. Clear chestnut.
4. *a*. Blond, yellowish.
   b. " reddish.
   c. " ashy.
   d. " clear.
5. Red.

Skin, color.
1. Absolutely black.
2. Brown, shaded with red.
3. Brown, yellowish or olive.
4. Reddish.

Skin, color.
5. Yellow or olive.
6. Yellowish white.
7. Brown white.
8. *a*. Rosy white.
8. *b*. Florid white.
9. Freckled.

By color
WHITE [Leucoid]
- *Blonds*. Anglo-Scandinavians or Kymri.
- Chestnut. Celto-Slavs.
- Brunette. Mediterraneans and Semites.
- Reddish (ruddy). One of the two Finnish types.

YELLOW
- Yellow proper. Races of Asia and Eskimo.
- Red
  - Red proper. Redskins and Caribs.
  - Yellowish red. Guaranis, Botoceodos.
  - Olive red. Peruvians.
- Blackish. Charruas (Uruguay); Anct. Cal., So. Dravidas.

BLACK
- Yellowish. Hottentots.
- Reddish. African Negroes.
- Blacks proper. Australians, Blacks of India; Tasmanians and Papuans, Negritos, African Negroes.

The cephalic index is the ratio of the greatest skull width divided by the greatest skull-length. As to the boundaries of the terms applied to these ratios, most unhappily the doctors disagree. Dr. Topinard's table is as follows:

Dolicocéphaly. 74 per cent and less.
- .64 and less Ultradolicocephaly.
- .65–.69 Dolichocephaly.
- .70–.749 Subdolichocephaly.

Mésaticéphaly. 75 to 79.9 per cent.
- .75, .76 Sub——.
- .77 Medium.
- .78, .799 Super.

Brachycéphaly. 80 per cent and over.
- .80 to .84 Sub——.
- .85 to .89 Super.
- .90 and over Ultra.

In addition to these the following terms are in use:

Acrocephaly. Skull high in proportion to the width.
Oxycephaly. Skull in shape of sugar-loaf.
Platycephaly. Noting flat skulls.
Chamæcephaly. Noting low skulls.
Stenocephaly. Noting narrow skulls.
Trochocephaly (τροχάω, to be round). Noting spherical skulls.
Macrocephaly. Noting large skulls.
Microcephaly. Noting small skulls.
Plagiocephaly. Noting oblique skulls.
Cymbocephaly. Noting skulls with hollow bregma.
Scaphocephaly. Noting skulls with keel-shaped crests.
Sphenocephaly. Noting wedge-shaped skulls.
Trigonocephaly. Noting triangular skulls.
Pachycephaly. Noting skulls with thick walls.

The application of the cranial index to the divisions of the human species previously considered, results as follows:

I. White races
- Dólicho
  - Anglo-Scandinavians, Franks and Germans. Fins
  - of one type, Mediterraneans.
- Mésati — Semites, Berbers, Egyptians.
- Bráchy — Celto-Slavs, Ligurians, Laps.

II. Yellow races	Dólicho	Eskimo, ancient Tehuelches, some Americans, Santa Barbara, Mecronesia here and there; in Asia here and there, Melanesians.
	Mésati	Polynesians.
	Brachy	American type, Alaska Siberia, Mongols, Mantchoos, Indo-Chinese Dravidians, Thibetans, Malay.
III. Black races	Dólicho	Australians, Veddahs and congeners, typical Melanesians, African Negroes, Bushmen.
	Mésati	Tasmanians, Mandingos, Haoussas.
	Brachy	Negritos of Malaysia and the Andamans.

It will be readily seen that the cranial index in its three branches applies to each of the three divisions of humanity (subspecies), the significance of which seems to be that the tendency to pass from one to the other belongs to the whole species rather than to any of its three divisions.

In this résumé we shall have space to mention but one other characteristic, stature:

Nomenclature of Stature.

Tall	men	1^m, 70 and above,	women	1^m, 58 and above
Ultramedium	"	1^m, 69 to 1^m, 65	"	1^m, 57 — 1^m, 53
Inframedium	"	1^m, 65 — 1^m, 60	"	1^m, 52 — 1^m, 40
Short	"	1^m, 60 — below	"	1^m, 39 — below

Combining this mark with all previously mentioned, Dr. Topinard groups the races studied as follows:

Vivo-nasal Index.	*Hair.*	*Cranial Index.*	*Skin Color.*	*Height.*	*Races.*
White subspecies. Leptorhine	Wavy (oval sec'n)	Dolichocephalic	Blond	Tall	Anglo-Scandinavians
			Ruddy	Tall	Fins, type I.
			Brown	Short (relative)	Mediterraneans
		Mesaticephalic	Brown	Short (relative)	Semites, Egyptians
		Brachycephalic	Brown	Short	Laps, Ligurians
			Chestnut	Medium	Celto-Slavs
Yellow subspecies Mesorhine	Coarse, straight round-section, long on the head, body glabrous	Dolichocephalic	Yellow	Short	Eskimo
			Reddish	Tall	Tehuelches
		Mésaticephalic (.76)	Reddish	Tall	Polynesians
		Brachycephalic	Reddish	Tall	Redskins
			Yellow	Short	Yellow race (of Asia)
			Yellow'h	Medium	Guaranis
			Olivish	Short	Peruvians
Black subspecies Platyrhine	Bushy (oval section)	Dolicocephalic	Black	Tall	Australians
			Yellow'h	Very short	Bushmen (steatopygians)
	Wooly (elliptical section)	Dolichocephalic	Black	Tall (eyebrow salient, nose deep at the root)	Melanesians
			Black	Tall	African Negroes
		Mesaticepalic	Black	Medium	Tasmanians
		Brachyceph'ic	Black	Short	Negritos

In a future number of the NATURALIST it may be advantageous to give Dr. Topinard's instructions about taking measures on the living.

MICROSCOPY.[1]

SOME ANATOMICAL AND HISTOLOGICAL METHODS.[2]—*I. A modification of Semper's method of making dry preparations.*—While it may be true that in many cases the preparations made according to Semper's method have an appearance similar to a gypsum model, they quite often present a dingy, weatherbeaten aspect that is by no means agreeable. The thin membranes and the connective tissues of dissections are left in a loose, wooly condition that grows worse by handling.

The microscopist completes his work by mounting his preparations in a solution of balsam. In like manner Semper's method may be completed by saturating the preparation with some solid that would fill up the pores, bind the parts together and restore the natural appearance. The solid which I have employed for this purpose is a mixture of Canada balsam, paraffine, and vaseline, but it is probable that a soft paraffine will in most cases do quite well. It is necessary that the mixture shall melt at about 46° C. (115° F.). It will be seen that the preparation is treated just as the microscopist treats an object when he wishes to obtain a consecutive series of sections. While yet saturated with the turpentine, it is to be immersed in the mixture, heated a little above the melting point and kept there until all the turpentine has been replaced. In many, if not in most cases, however, the turpentine may be allowed to evaporate before the preparation is put into the melted paraffine mass. The latter then quickly penetrates the tissues and the work is simplified. The preparation is then to be kept in an oven vessel warm enough for the excess of paraffine to melt and drain off. It may then be wrapped in cloths or in bibulous paper until the whole of the paraffine mixture adhering to the outside has been dried off.

The advantages to be derived from pushing the process to this stage are the attainment of a greater degree of firmness and strength in the specimen, the obviation of the bleached appearance assumed on the escape of the turpentine, and the restoration of the natural colors. Probably any colors will reappear that will endure immersion in alcohol. In the case of anatomical preparations made in the way described, injected vessels show to advantage. I have also prepared specimens of lizards, small turtles, fishes, mussels and earthworms; and whenever the tissues have been thoroughly saturated with the wax mass, the results have been satisfactory.

II. A method of making double injections for dissecting purposes.—A brief notice of Professor H. F. Osborn's method for double injections appeared in *Science Record*, II, Feb. 15, 1884, p. 84. His plan appears to have been to fill the whole vascular

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.
[2] By Professor O. P. Hay, Indianapolis.

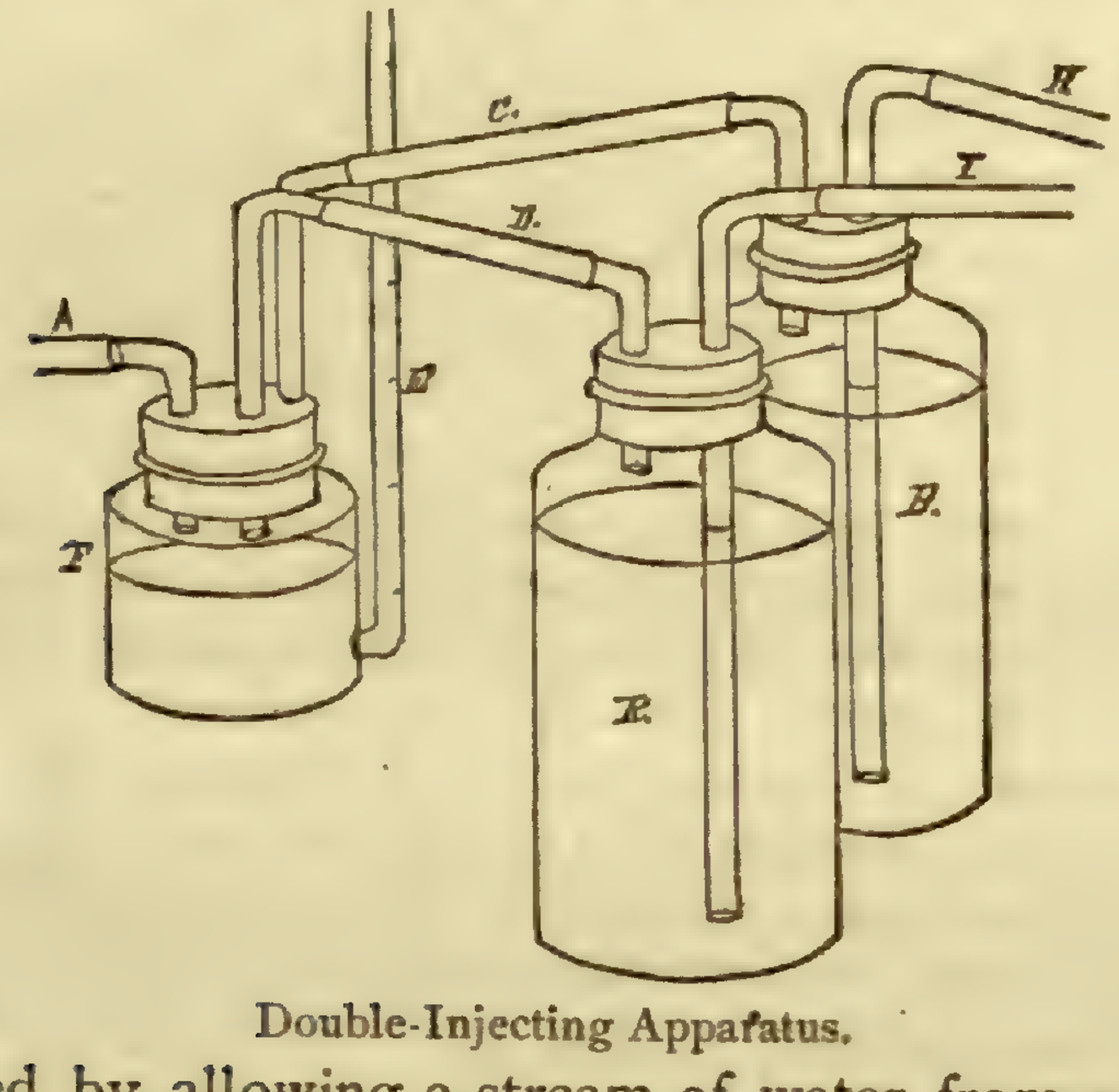
system with a thin colored injection mass, as in making an ordinary injection. When this has passed through the capillaries and well filled the veins, there is forced into the artery a differently colored *plaster mass* which pushes the previously injected thin mass before it until the plaster has reached the capillaries, where its onward movement is arrested. For a year or more before Osborn's notice was published, double injections based on the same principle had been made by the writer. As practiced by myself, a canula was fitted into the aorta of a cat, and a gelatine mass colored with carmine was injected until it was seen to flow from the right side of the heart; then the tube conveying the red mass being detached, a tube conveying a blue gelatine mass was slipped over the same canula, and the pressure again applied. Into this blue mass had been mixed thoroughly a quantity of starch, preferably from wheat. This starch-bearing mass pushed the carmine mass before it until the starch grains entered the capillaries and effectually plugged them up. The arteries were thus left blue and the veins red, and so well was the work accomplished that a lens of considerable power had to be used to discover any admixture of the colors in the smallest vessels of thin membranes. The first mass injected need not be unusually thin.

The capacity of the capillaries is so great, as compared with that of the arteries, that any commingling of the two colors is concealed in them. Carmine is used for the veins because of the ease with which it may be prepared, its permanence and the facility with which it passes through the capillaries. On the other hand, the gelatine for the arteries may be colored with the coarser pigments, such as Prussian blue or ultramarine. The latter furnishes a beautiful blue. Vermilion is not suitable for the first injected mass, since on account of its high specific gravity it readily sinks to the lowest side of the vessels, drags behind, and causes a commingling of the colors. An additional reason for filling the veins with red rather than with blue is found in the agreeable and natural color given to the preparation.

Of course a mass of plaster of Paris injected after a gelatine mass will drive it until the plaster reaches the smallest vessels, thus producing a double injection. The starch mass recently proposed as a filling for blood-vessels will readily lend itself to the production of a double injection according to the method detailed above.

III. A method of producing double injections for histological purposes.—So far as I am aware the usual method of producing a double injection of the blood-vessels preparatory to making sections for the microscope, is to inject first a gelatine mass of one color into the artery until the increasing pressure gives notice that the mass is entering the capillaries, and immediately after to inject a differently colored mass into the vein. The injection be-

ing thus accomplished one of two things, it seems to me, is likely to happen; either the vessels will not be well filled or the mass intended for one set of vessels will be driven through into the other. To avoid these accidents I have practiced the method of filling both sets of vessels at the same moment and under exactly the same pressure. This pressure is kept low at the beginning so that all the arteries and veins shall be thoroughly filled before either mass begins to enter the capillaries. Then as the pressure is increased the differently colored masses meet each other in the capillaries; and if the pressure on each is equal, the vessels may be filled as full as compatible with safety without danger of either color being driven from one set of vessels into the other. The way in which this result is accomplished will be understood better by reference to the accompanying drawing. The desired press-



Double-Injecting Apparatus.

ure is secured by allowing a stream of water from a hydrant or from an elevated cistern to flow into a tight vessel. A two gallon petroleum can does quite well. As the water flows in the air is forced out through a rubber tube, *A*, into the wide-mouthed bottle, *F*, whose tightly fitting cork gives passage to two other glass tubes. These extend below just through the cork and above connect respectively with the rubber tubes *C* and *D*. Into the side of *F*, near the bottom is fitted another tube, *E*, reaching to a height of ten inches or more, open above, and graduated into inches. If preferred, this tube may also pass through the cork and extend down well into the mercury with which *F* is partly filled. *B* is a bottle of suitable size in which is contained a blue injection mass for filling the veins, and *R* a similar bottle containing a red mass for the arteries. The interiors of these bottles are connected with the bottle *F* by the tubes *D* and *C*. Each of the bottles, *B* and *R*, has a tube which, starting from near the bottom, passes through the cork, and is, a little above this, bent at right angles. With these are connected the rubber tubes, *H* and *I*.

Now when water is allowed to flow into the reservoir mentioned above, the air is forced out through *A* into *F*, and thence along the tubes *D* and *C* into *B* and *R*. As soon as the pressure in these bottles becomes sufficiently great, the liquids which they contain will be driven out through the tubes *H* and *L*. If there should be any obstacle to the escape of these fluid masses, the pressure in all the vessels will rise and be registered by the height of the mercury in *E*.

If now it is desired to inject, for instance the kidney of a pig, a canula made of a glass tube must be fitted securely into the renal artery and a similar one into the renal vein. The canulæ must be of such a size that the rubber tubes, *H* and *I*, will fit them well. Heat the gelatine masses in the bottles, *B* and *R*, to the proper temperature and keep them so heated until the injection has been finished. Special care must be taken with the tubes, *H* and *I*, to prevent the gelatine passing through them from becoming frozen. Now having clamped the tube, *H*, have an assistant turn on a small stream of water until the gelatine begins to flow slowly from *I*. If the diameter of the canula is not too small it may be held with the free end directed upward and filled with gelatine allowed to drop from the mouth of *I*. Then slip *I* over the canula. Unclamp the tube, *H*, and when the gelatine from *B* has begun to flow, slip it over the canula inserted in the vein. Then increase the pressure gradually until it has reached as high a point as experience has taught to be safe for the organ operated on.

By means of this apparatus, which will require the expenditure of only a few cents and a little ingenuity, double injections may easily be made of any organs whose veins are not provided with valves. I have made injections of the kidney whose arteries and glomeruli became uniformly filled with the red mass and whose veins and the system of capillaries surrounding the renal tubules became filled with the blue. The lungs and the liver are easily and successfully injected. I have been less successful in injecting the organs that send away their blood current through the portal vein; but I have no doubt that they too may be injected.

Triple injections of the liver may be made by first injecting the hepatic artery with a green mass until the whole liver assumes a green tint, and afterwards injecting the portal vein and the hepatic vein with red and blue as above directed.

The same apparatus may be employed to make either single injections or the double injection described under the second head of this paper, by simply clamping one of the tubes, *C* or *D*. As a matter of course care must be taken that all the corks fit tightly in the bottles, otherwise the internal pressure may force them out at the very moment when an accident will do the most damage.

SCIENTIFIC NEWS.

— Titian Ramsay Peale died in Philadelphia, March 13. He was the last surviving son of Charles Willson Peale, the famous portrait painter of Revolutionary times. For the past ten years he has resided in Philadelphia. He was born in October, 1799. He was an enthusiastic naturalist, and was noted for his collections of moths and butterflies. He was one of the founders of the Philosophical Society of Washington, and was the sole survivor of Col. Long's celebrated "Expedition to the Rocky mountains," to which he was attached as assistant naturalist. He was also one of the naturalists with the U. S. exploring expedition of Commodore Wilkes.

— The Sea-side Laboratory, at Annisquam, Mass., will be open to students during the coming summer from July 1st to Sept. 1st, 1885. The instruction and work of the laboratory will be under the immediate care of Mr. B. H. Van Vleck, assistant in the laboratory of the Boston Society of Natural History. Applicants should address Professor A. Hyatt, curator of the Boston Society of Natural History.

— The Mexican government has appointed a commission for the scientific investigation of the natural products of the country. It includes a number of gentlemen who reside in different parts of the republic. The president of the commission is Dr. Fernando Ferrari of the city of Puebla.

—W. Curtis Taylor, 1328 Chestnut street, Philadelphia, has taken a series of composite photographs of the officers of the American Association for the Advancement of Science of 1883–4. They compare favorably with those of the National Academy of Sciences taken in 1883.

— Dr. F. Ritter von Stein, professor of zoölogy in the University of Prague, well known for his beautifully illustrated and elaborate works on the genital organs of insects and on the Infusoria, died in February last.

— Mr. E. C. Rye, of London, well known as a coleopterist, and the editor of the *Zoölogical Record*, died Feb. 7th, aged 52. He was a man of versatile talents, and a pleasant person to meet.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, March 7. — Communications were made by Dr. C. A. White on the use of gutta-percha in making casts of fossils; by Dr. H. G. Beyer, U.S.N., re-

port on intracellular digestion and its relations to pathology; by Mr. G. Brown Goode, remarks on the velocity of animal motion.

March 21.—Communications were made by Mr. Wm. H. Dall on the Marsupium of Milneria; by Prof. J. W. Chickering, Jr., exhibition of some botanical drawings and paintings; by Dr. Tarleton H. Bean, some features of collecting at Cozumel island, Yucatan; by Dr. J. A. Ryder, on the development of the mammary glands in the Cetacea; by Mr. Lester F. Ward, phyllotaxy of *Paulownia imperialis.*

NEW YORK ACADEMY OF SCIENCES, March 2.—The following paper was read: Meteorological and hypsometrical notes in the islands of the Curaçao group, West Indies, by Dr. Alexis A. Julien.

March 23.—The following paper was read: Notes on building-stones (with illustrations), by Mr. Arthur H. Elliott.

March 30.—The following paper was read: On the trigonometric and topographic surveys of the United States (illustrated by lantern slides, and the exhibition of instruments actually employed in the field), by Prof. Wm. P. Trowbridge.

BOSTON SOCIETY OF NATURAL HISTORY, March. 4.—Dr. E. G. Gardiner spoke of the development of the bill and epidermis in the chick.

March. 18.—Mr. C. E. Ridler read papers on some of the rare plants of Kingston, Mass., and on some ancient stone implements from the same locality.

AMERICAN GEOGRAPHICAL SOCIETY, March 19.—Mr. Ernest Ingersoll delivered a lecture entitled, How the settlement of North America has affected its wild animals.

APPALACHIAN MOUNTAIN CLUB, March 11.—The following papers were presented: Some of the hills of Plymouth county, by C. E. Ridler; altitudes in Massachusetts, with a sketch of the Massachusetts trigonometrical survey conducted by Simeon Borden, 1830–1840, by E. G. Chamberlain; a week in the Pemigewasset wilderness, by Rev. H. P. Nichols (read by R. F. Curtis).

Special Meeting, March 20.—An ascent of Ben Nevis, illustrated with a few lantern views, was presented by A. E. Scott; a trip from the Connecticut lakes to the Rangeley lakes, was read by R. B. Lawrence.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Jan. 27.—Miss A. M. Fielde gave the results of a series of experiments upon the power of regeneration of lost parts possessed by earthworms

(Lumbricus). Fifty-eight days after decapitation the worm had reproduced not only the brain, but the œsophageal collar and œsophageal ganglion. In one of the specimens exhibited, the lobes of the brain-mass were about one-half of the normal size; a second had progressed further, while in a third the brain and ganglion were normal. The only perceptible difference between the regenerated ganglion and the original brain was a somewhat paler color.

Feb. 17.—Miss Fielde stated that when twenty or more segments, constituting the posterior portion of a worm, were cut off behind the clitellum, regeneration never took place at the cut end, but by the insertion of new pieces. Mr. Meehan accounted for the sparse distribution of the cedar of Lebanon by attributing it to the solidity of the cones, which never open, though the seeds are winged, and therefore designed for wide distribution. He believed it probable that this close habit of the cones has only existed in comparatively recent times. The Indian species is so closely related that it probably sprang from the same ancestral stock. The only young trees which grow in a state of nature are produced from cones which rot in rock-crevices or are broken by accident. Professor Heilprin read a paper upon disputed points in geology and palæontology, with special reference to the greater adaptability of the lower forms of life to changed surroundings, and their consequent persistence in later geological deposits, as compared with the rapid extinction of higher types. Arguments were adduced in favor of homoplassy in evolution or the origin of the same generic or even specific forms by distinct lines of ancestors, and the reappearance of extinct genera and species in subsequent geological epochs.

Feb. 26.—Mr. Potts described a new Hydrozoan from Tacony creek. This creature has a cylindrical body, surrounded at its free extremity by sixty or seventy papillæ, but without tentacles. Very long lasso-threads are present. The usual length of the creature is about $\frac{1}{60}$ of an inch. The ectoderm is an almost homogeneous hyaline substance filled with large cells. It was thought that a clear central space had been seen, and that a faint channel ending in a mouth could be traced. This appears to be the most primitive form of Hydrozoan yet described, its power of motion is very slight, and how it can capture prey without tentacles is a mystery. Mr. Potts suggested that it might be the larval state of a more developed form, as it had not changed, but had budded from the base. Professor Sharp argued in favor of the view that this organism, in common with other fresh-water organisms, has degenerated from a somewhat higher type. Mr. Potts stated that he had received from Pictou Lake, Nova Scotia, specimens of the statoblasts of a new species of sponge. Specimens collected just before Christmas indicated that it was an evergreen species.

ERRATUM FOR APRIL NATURALIST.

Owing to the absence from the country of both the leading editors during last month, some typographical errors occur in the last number of the NATURALIST. The most important of these is on page 346, where a foot-note containing the classification of the Taxeopoda is included in the text of the classification of the Mammalia. Therefore, p. 346, lines two to eighteen from bottom, transfer to foot of page, under note 3. Ibid. bottom line, change "7" to 6, and numbers in following lines to coincide.

PLATE XVII.

An Eskimo family at Hopedale, Labrador. From a photograph.

THE

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THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

I. THE THREEFOLD NATURE OF EVOLUTION.

AT what level in nature does consciousness first come definitely into existence? This is one of the most difficult of the problems of science, and one which, perhaps, can never be clearly answered. At the limiting boundary of conscious and unconscious action it is quite impossible to tell, by any means at present at our command, whether blind force or intelligent agency is at work. Even within our own bodies it is difficult to limit the kingdoms of consciousness and unconsciousness, and equally difficult to decide that actions which seem now wholly unconscious were originally so. This question cannot always be decided by the claim that here reason has evidently been at work, and there only natural selection. For the results of reason and natural selection, as applied to the modification of the body and of its habits, are singularly alike. In each case adaptation to external conditions is produced, and there can be only certain definite adaptations to each limited set of conditions. Thus if the results of two energies are of precisely the same character, it is impossible to decide from these results which energy has been active. Where the change has been too rapid for the powers of natural selection, we may be sure that consciousness has been at work. But in the case of very deliberate changes we cannot positively decide to which force they are due, and some degree of conscious action may extend to a much lower level in the realm of nature than we usually imagine. On the other hand natural selection may be the sole active agency up to a somewhat high level.

Evolution has its three distinct and dissimilar phases, on each

of which natural selection acts, though it is customary to apply this principle to only the second of these phases. These are the chemical, the functional and the psychical. So far as organic evolution is now concerned, chemical development has become of minor importance. Yet originally it was of supreme importance. In fact, the whole vast range of inorganic chemical development was a necessary preliminary to organic existence, and constituted the primary phase in that grand whole of evolution which is a continuous and not a broken chain.

Very probably, in the primeval period, inorganic chemism yielded far more complex compounds than any it now presents. The conditions of temperature at that period, and the fluid state of many elements which are now found only as rigid solids, must have aided such a chemical activity. Even now more complex compounds than we find would doubtless exist but for a reason to be considered further on. This primeval chemical evolution may have gone on for ages without impediment, yielding steadily higher and more complex products, every fixed stage of which formed the basis for a new upward step of material development, until finally a stage approximating to that of protoplasm was reached. But long before this stage was attained, it is highly probable that functional evolution came into play, and at once acted as a check to the rapid progress of chemical development. As soon as an unstable colloid compound was thus produced, so constituted as to be subject to the disintegrating attacks of oxygen, self-motion of such matter may have begun, and the long reign of functional activity originated. This is all we find in functional life now, the self-motion of unstable colloids through the action of the energy set free by oxidation, and it is quite probable that such activity began as soon as a primeval colloid, of suitable constitution, was produced.

But chemical evolution could not have ceased with this first appearance of functional action. It must have long continued, yielding products of higher and higher complexity, and more susceptible to the function-producing influences, until finally the excessively mobile compound now called protoplasm originated. Yet there can be no doubt that with the earliest appearance of functional activity a check was placed upon chemical development. This check grew more vigorous as functional action became more unfolded. Finally a practical limit to the increase of chemical

integration was reached, and functional activity took its place, as the second great agent in evolution. Yet this check to chemism could have been by no means completed with the first appearance of active living forms. Superior and more susceptible proteids may have continued to appear, perhaps to the very borders of the present time, rendering the operation of functional change more and more active and capable. There is certainly good reason to believe that the protoplasmic basis of all beings is not identical, and if so, that chemical evolution may have continued, with ever-decreasing efficiency, throughout the whole long period of organic existence. As for the utter disappearance of the link forms between protoplasm and the highest existing inorganic compounds, it is no more surprising than the similar disappearance of so many of the link forms of life. They have been crowded out of existence by natural selection. Protoplasm doubtless has its embryology, whose steps, if we could trace them all, would lead us to a knowledge of its phylogeny. Many of the high-atomed products which successively appear in the development or during the disintegration and decay of organisms may be identical with primeval compounds which preceded protoplasm. Yet all of these have their enemies in the vast and varied hosts of fungi which depend upon them for nutriment. They no sooner cease to be protected by the energies of active life, than they are assailed and partly reduced to simple inorganic conditions, partly become food for fungi.

We can readily conceive, then, that were high-atomed chemical compounds now formed from the elements, by inorganic agency, they would in all probability be at once attacked by fungi, and consumed as nutriment or disintegrated. The incessant activity of the fungoid organisms places a definite check on any high inorganic evolution under present conditions. Yet, as above said, in the existing formation of protoplasm, its phylogeny is indicated precisely as the ancestral forms of the higher animals are indicated in their embryological development. Many of the steps may be slurred over in the one case as in the other, and in the formation of protoplasm by the plant, through successive integrations, from carbonic acid, water and ammonia, we may have a greatly shortened and masked preservation of the original steps of the development of protoplasm from the inorganic elements. The time may come when the human form can be phylogeneti-

cally traced, not only to the rhizopod, but to the chemical elements.

The second great phase of material evolution, the functional, which has gradually unfolded until, from forms lower than the rhizopods—mere homogeneous masses of protoplasmic molecules—it has produced the extraordinarily intricate and heterogeneous form of man, as the highest existing stage of material combination, is due to the operation of two characteristics inherent in protoplasm. The first of these is the power of self-movement, through the agency of internal energy set free by oxidation. The second is the power of inducing new chemical action to the production of new protoplasm. The mode of operation of this second agency is as yet in great part a mystery. But that it exists is too evident to be for a moment questioned. And there is considerable reason to believe that these two agencies do not act simultaneously, but that oxidation of protoplasm and reintegration of the same are always successive processes in the organic economy.[1]

At some period in this long process of organic development there came into operation a third distinct phase or process of evolution, the psychical or mental phase. It is this with which we are here alone concerned. Its appearance and unfoldment seem related to functional action as the latter is to chemism. Psychical action has constantly tended to check functional variation, and to replace it by a new controlling agency. As organic action slowly checked the development of chemism, and at last wholly or nearly superseded it, so psychical action has opposed the energy of functional variation and, in the case of man, has largely superseded it. The three modes of energy here indicated are probably all due to the action of forces inherent in the constitution of matter, and some of the conditions of this action are very evident. These it may not be amiss to briefly indicate.

Every mass of matter, however composed, is constantly affected by two sets of forces, those acting internally and tending to preserve and increase its complexity of organization, and those acting upon it from the external world and tending to reduce or destroy its complexity. In chemical integration the internal energy is in the ascendant. The compound is formed by the innate forces of its elements, and grows more complex through

[1] See The Organic Function of Oxygen, AMER. NAT., Feb. and March, 1883.

the continued activity and supremacy of these forces. Yet all such compounds are constantly subject to the action of external forces, and are occasionally disintegrated or otherwise affected thereby. The more complex the compound the more exposed is it to the disturbing influence of external energy. At the same time the more complex the chemical compound, the less vigorous is the action of the innate energies of affinity. It is evident, therefore, that at some point a balance between these opposed energies must be reached. While chemical energies continue superior there must be a gradual increase in the complexity of compounds, despite the assaults of external energy. But when these opposing energies become definitely equal in vigor, it seems evident that a fixed status must result. There may be upward and downward swings, as one or the other agency gains a temporary supremacy, but the general level cannot permanently be departed from.

Such is apparently the chemical status of protoplasm. It indicates the level of balance between internal and external energies. If it be broken down by a vigorous influx of external energy, the activity of chemical energy becomes superior, and reintegration sets in until the balance of forces is again attained. Chemism cannot go further and produce a stable compound of higher complexity. Yet there is good reason to believe that unstable compounds of this high character are frequently produced, molecules lifted above the general level, and therefore liable to break down instantly at the least influx of external energy. It is probably to the existence of such excessively complex molecules that the high sensitiveness of nervous and muscular tissue is due. Lifted too far above the level of harmony of the forces, they break down at a touch.

Other results follow. Motor forces are set free within the tissue which give it self-motion. This self-motion brings it into new relations with external substances, and other changes than purely chemical ones follow. Variations in form and constitution in response to these external influences take place. Natural selection upon function and form comes into play, and the organism that resists the adapting influence of external energy ceases to exist. Only those mobile organisms that readily yield to the molding influence of external energy, and closely adapt themselves to the conditions of nature continue to exist. Thus in the

chemical phase of evolution internal energy is in the ascendant and controls the results. In the functional phase chemical energy merely holds its own, and a fixed molecular status is gained. But external energy acts upon tissue as a whole, and produces definite variations in form.

If we now come to consider psychical evolution we find it still to be a question of the interplay of internal and external energies. Reference here is made to its purely physical results, and not to its important characteristic of consciousness. In the growth of psychical conditions we still have to do with the external energies which play upon the body and force their way into it over the channels of the nerves. But as the body improves in its sensory organization, and permits the ready inflow of external energy, the balance between the two series of energies is broken, external energy becomes in excess and there is a tendency to break down the molecular complexity of the body to a lower level. Could all those inflowing energies play upon the muscles a fixed fall in the chemical level must succeed. As it is, however, these energies are checked in their inflow. The muscles are permitted to receive no more than they are prepared to accept. The remainder are restrained in their action to the cerebral ganglion, where they exert an organizing influence upon some substance whose character is as yet a problem. This is the third or psychical phase of organic evolution.

The motor energies, thus drafted off into this cerebral substance, there combine into a congeries of forces of yet unknown character, which we call the mind. It has two characteristics. The energies which constitute it are persistent. And they enter into new combinations which have no counterpart in external nature. It constitutes a new center of force which in its turn acts upon the body and aids in molding it. External forces are no longer supreme. A reservoir of internal energy has been formed which frequently acts in opposition to them. And one of the most essential characteristics of the action of this mental center of force is, that its activity is not exhausted upon the body. In fact it finds an important field of action in the external world. It molds nature as well as the body. In place of the organism needing to adapt itself to external conditions, it acts to adapt external conditions to itself, and its own need of change is obviated to the extent that it acts upon and remodels the world without.

All the numerous products made by man, his clothing, habitation, tools, &c., and all the changes in the conditions of nature produced by his agency, are results of this third phase of evolution. Functional change is forced upon the external world, and to that extent ceases to act upon the body. Harmonious adaptation continues necessary, but nature is made to adapt itself to man, and man has little need to adapt himself to nature. It is not, however, a simple reaction, through the body, of external forces upon external nature. A reaction of this kind exists throughout organic life. Every motion of an organism in direct response to the impulse of external influence exerts an influence upon external nature. But as a rule it produces no new conditions. Adaptation is mainly confined to the body. In psychical action, however, new conditions are produced. The energies which have flowed into the cerebral reservoir are there recombined into new aggregates, or ideas, as we name them. These, in their reaction upon external nature, produce new conditions, embodiments in matter of new relations of energy, and the substances external to the body are forced to adapt themselves to the needs of the organism.

This psychical reaction upon external nature is not a common characteristic of animal action. It is specially active in man, and presents a considerable activity in some of the lower tribes, as the beavers, the ants and the bees. But in the great majority of animals it is almost non-existent. Very few even of the higher vertebrates make any effort to adapt nature to their needs, but accept existing conditions. In such cases all the molding action of energies must be exerted upon their bodies, and such adaptation as becomes necessary must be confined to the organism.

Yet psychical action in these lower animals is not without its special results, distinct from those yielded by the direct action of external energies. It yields rapid variations in the habits of the animal, adapted to particular cases, and which often enable it to survive where otherwise it would perish. These may be special movements in flight or combat, new modes of concealment, the display of cunning in non-habitual manners, and the like. In fact, in the difficulty of deciding whether any animal is influenced by mental energies or not, we are in great measure dependent on the occurrence of unusual actions, adapted to special situations. If actions are habitual they may be unattended by con-

sciousness, even though they seem to display the utmost accuracy of reasoning. Natural selection yields results so closely analogous to those of reason that it is almost impossible to discriminate between them, and in fact quite impossible except where a change of habits is displayed too great and sudden to be possibly due to the action of unconscious agencies on the slight congenital variations in animal forms.

In attempting to decide, then, at what level of life consciousness comes into definite existence, we are met with this difficulty. Actions of the most intricate character, such as many of those performed by the ants, for instance, are not beyond the conceivable powers of natural selection if they have been for very many generations practiced, with extremely slow variations, by one species. Yet ants adapt nature to their needs, and thus counteract the action of physical conditions upon their bodies. Therefore that phase of activity which we have above considered specially significant of psychical agency—the remodeling of external conditions—seems to be not beyond the scope of natural selection, and only where the adaptation is individual instead of tribal, and rapid instead of gradual, can we be sure of its psychical origin.

If, for example, we consider the great kingdom of vegetable life, there are abundant reasons to believe that, in all of its higher manifestations, at least, it is devoid of consciousness. And yet its adaptations to the conditions of nature are often so complex and extraordinary that it seems almost incredible that they could have arisen without the aid of reason. Only the unpitying energy with which nature weeds out all illogical adaptations can explain the logical consistency of those that persist. If the habits of an animal change in response to logical reasoning, this change must be in the direction of exact adaptation to nature. But the same end is achieved by the blind but vigorous agency of selection, which is utterly merciless to the ill-adapted. If we could imagine plants to be suddenly given the power of motion, and thus brought into new and more varied relations to nature, it is evident that their adaptations might become yet more intricate, and still more like the results of intelligence and judgment, though gained through the action of unconscious influences. In such a case they might readily rival many of the lower animals, and unconsciously perform actions closely analogous to those which it

is usual to ascribe to consciousness. In fact, the plant world is not utterly destitute of such motor powers. The mycelium of the Myxomycetes so closely simulates the Amœbæ in its motions that it is difficult or impossible to distinguish it from the latter. Yet it is but a plant in motion, and is undoubtedly unconscious. Again the white blood corpuscles of animals are also indistinguishable from Amœbæ in character and habits; yet we can scarcely credit each of them with conscious life. At a higher level in plant life we again meet with motor powers. Thus the carnivorous plants display characteristics not unlike those seen in the polyps; yet they are unquestionably unconscious, and we might safely ascribe a similar unconsciousness to the polyps and all other animals of similarly low grade.

Thus if we begin at the lower levels of organic life, and trace nature upward in her development, it is very difficult to perceive where the influence of heredity and natural selection ceases to act and conscious choice enters into life as an element. On the other hand if we commence with the conscious life of man, and trace nature downwards, it is equally difficult to decide where consciousness ends. For at a certain intermediate level the phenomena observed might safely be ascribed to either conscious or unconscious action. Both seem capable of producing them, and it is utterly impossible to decide, with our present knowledge of the subject, which does produce them. Where there is evidence of unusual choice in some animal, or marked variation from its hereditary habits, we can be sure of conscious activity. On the other hand, where there is no nervous system, and no cerebral organ or force reservoir, we may reasonably question the existence of psychical powers. And yet, even in this extreme case, we cannot positively declare that consciousness does not exist. In fact, although we may imagine that we are considering two conditions of whose actual existence we have equal knowledge, such is really not the case. Man finds in himself his only standard of comparison. We know that within ourselves consciousness exists, and oversees, though it may not directly control, the great mass of our actions. We know, on the other hand, that many of our actions are performed unconsciously. In considering the activities of lower nature, then, we cannot actually know that consciousness may not, to some extent, accompany them. We have some warrant to say that the unconscious action, which

is exceptional with us, is the rule with them, but we can at no level positively declare, "here it is absolutely impossible that consciousness should exist." We must understand the subject far more thoroughly than now ere this question can be definitely decided.[1]

(To be continued.)

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KITCHEN GARDEN ESCULENTS OF AMERICAN ORIGIN. II.

BY E. LEWIS STURTEVANT, M.D.

(Continued from p. 457, May number.)

Jerusalem Artichoke.—Botanical analogies and the testimony of contemporaries agree, as we have seen, says De Candolle[2] in considering this plant to be a native of the north-east of America. It was introduced to England about 1617, as we learn from the second edition of Gerarde,[3] and this is nearly coincident with the first mention of this species in Europe, that by Fabio Colonna.[4] Lescarbot brought these roots into France about this time.[5] "Hartichokes" are mentioned as growing in Virginia in 1648,[6] and "artichokes" were cultivated at Mobile in 1775, but whether this plant or not, does not appear from the context.[7] They are mentioned by writers on American gardening from 1806 onward.[8] In Pennsylvania the tubers are yet raised by some and sent to the New York market, "they are disposed of for lunch purposes and there is a ready sale."[9]

Most interesting articles on the geographical and botanical history of this plant, by Messrs. J. Hammond Trumbull and Asa Gray, will be found in the *American Journal of Science*, May, 1877, and April, 1883.

Martynia.—Two species, *Martynia proboscidea* Glox. and *M. lutea* Lindl., occur in our gardens, the seed pods while yet tender

[1] See in this connection Cope, On Catagenesis, AMER. NAT., Oct., 1884.
[2] Orig. of Cult., Pl. 44.
[3] Herbal, 1636, 753.
[4] Ecphasis minus cognitarum stirpium, Rome, 1616.
[5] Hist. la Nouv. France, 1618.
[6] A Perfect Disc. of Va., Lond., 1649, 4.
[7] Romans, Nat. Hist. of Fla., I, 115.
[8] M'Mahon, 1806, Gardiner and Hepburn, 1818, as good for hogs and cattle, Fessenden, 1828, etc.
[9] Agr. of Pa., 1883, 358.

serving for pickles. The former was first known in Europe in 1738, the latter, a South American species, not until 1824.[1] *M. craniolaria* Glox., the white flowered, has appeared by name in one at least of our seed catalogues among garden vegetables. It was described in 1785. *M. violacea* Engelm. occurs in the South-western States, and the Apache Indians gather the half ripe seed pods to be used for food.[2]

The Martynia was not an inmate of our kitchen gardens in 1828, not being mentioned in Thorburn's seed catalogue of that date, nor in Noisette's Manual du Jardinier. It is not mentioned for American gardens by Schenck in 1854,[3] but is by Burr in 1863.[4] It hence may be considered as of recent introduction.

Nasturtium.—*Tropæolum majus* L. and *T. minus* L., find place in our seed catalogues for use as a garnish and salad, and the unripe seed pods for salads and pickling. Both are natives of Peru. The former came to Europe in 1684, according to Linnæus,[5] or 1686, according to Noisette,[6] and according to Collinson's manuscripts it reached England in 1686. The dwarf nasturtium was known at Lima in 1580 by Dodonæus, was cultivated in England by Gerarde in 1596, and was a great favorite with Parkinson in 1629; it was then lost, but afterwards reintroduced. Miller, in 1768, says it was then only less common than the tall.

Both the tall and the dwarf were in French kitchen gardens in 1828,[8] but the tall seems to have then only reached our culture, as the dwarf is not mentioned in Thorburn's seed catalogue of 1828. The tall is mentioned by M'Mahon as in American gardens in 1806, by Gardiner and Hepburn in 1818, and the tall and dwarf by Bridgeman in 1832. Both were grown in English gardens in 1778.[9] One common name, "Indian cress," used as late as 1854 by writers on American gardening, would suggest that the use as a vegetable was coincident with its second introduction, as Parkinson's fondness for it would seem to imply.

[1] Noisette Man. du Jard., 537.
[2] Dept. Agr. Rept., 1870, 422.
[3] Gard. Text-book.
[4] Field and Gard. Veg. of Am.
[5] Miller's Dict.
[6] Man. du Jard., 508.
[7] Miller's Dict.
[8] Noisette, Man. du Jard., 337.
[9] Mawe's Gardener.

The nasturtiums have received greater welcome in our flower gardens than for table use, and a large number of varieties have been developed as florists' plants.

Peppers.—There seems to be now scarcely a doubt as to the American origin of the peppers, *Capsicum sp.* It seems, however, to have escaped the attention that it deserves, that the large number of forms already developed at the time of the discovery of America is indicative of a long cultivation, and adds testimony to the agricultural habits of the people. A vernacular name, especially if short, is very persistent in its horticultural use, and in those varieties of vegetables which are grown in kitchen gardens, some names alone, without descriptive text, may be assumed as indicative of the existence of a variety to which the same name is applied to-day. Such investigations as we have made indicate that this is especially true for the peppers.

How many species there are of peppers I cannot make out. Many described species can be unhesitatingly referred to *Capsicum annuum*, a species of great variability, and which seems to be a perennial in some regions, as in Florida, as I am informed, and in Chili, according to Molina. We shall make use of the specific names as we find them.

According to Bancroft[1] the use of peppers by the Southern natives was as great in ancient times as is now observed. Sahagrun[2] mentions chili more frequently than any other herb among the edible dishes of the Aztecs; Veytia[3] says the Olmecs raised chili before the time of the Toltecs. "It is the principal sauce and the only spice of the Indians" as Acosta writes in 1578, and Schomburgh says that the present Indians of Guiana eat the fruit of these plants in such abundance as would not be credited by an European unless he were to see it. Columbus carried peppers with him on his return voyage in 1493,[4] and Peter Martyr, in his epistle dated September, 1493, says it was "more pungent than that from Caucasus."[5] In 1494 a letter written by Chanca, physician to the fleet of Columbus on his second voyage, to the Chapter of Seville, refers to its use as a condiment. Capsicum and its uses are more particularly described by Oviedo,

[1] Native Races, II.
[2] Hist. Gen., II, lib. VIII.
[3] Hist. Ant. Mej., I, 154.
[4] Irving's Columbus, I, 238.
[5] ib., III, 425.

who reached tropical America from Spain in 1514. Clusius asserts the plant was brought from Pernambuco by the Portuguese to India, and he saw it cultivated in Moravia, in 1585.[1]

Hans Stade,[2] during his captivity in Eastern Brazil, about 1550, says the "pepper of the country is of two kinds; the one yellow the other red; both, however, grow in like manner. When green it is as large as the haws that grow on hawthorns. It is a small shrub about half a fathom high, and has several leaves: it is full of peppers which burn the mouth." G. de Vega,[3] writing of Peru in 1609, says the most common pepper is "thick, somewhat long, and without a point. This is called '*rocot uchu*' or 'thick pepper,' to distinguish it from the next kind. They eat it green, and before it assumes its ripe color, which is red. There are others yellow, and others brown, though in Spain only the red kind has been seen. There is another kind, the length of a *geme* (5 inches ?), a little more or less, and the thickness of the little finger. These were considered a nobler kind, and were reserved for the use of the royal family. * * * * Another kind of pepper is small and round, exactly like a cherry with its stalk. They call it '*chinchi uchu*,' and it burns far more than the others. It is grown in small quantities, and for that reason is the more highly esteemed." Cieza de Leon,[4] who traveled in Peru, 1532–50, speaks of the Capsicum as a favorite condiment of the Peruvian Indians. Molina[5] says many species of Capsicum called by the Indians "*thapi*" are cultivated in Chili, among others the annual, which is there perennial, the berry pimento and the pimento with a subligneous stalk. Wafer, 1699,[6] says on the isthmus they have two sorts of pepper, the one called *bell* pepper, the other *bird* pepper, and great quantities of each are much used by the Indians." Each sort grows on a weed or shrubby bush about a yard high. The *bird* pepper has the smaller leaf, and it is by the Indians better esteemed than the other." Ligon, 1647–53,[7] also mentions two sorts in Barbadoes, "the one so like a child's corall as not to be

[1] Pharmacog., 406.
[2] Hak. Soc. ed., p. 166.
[3] Royal Com. Hak. Soc. ed., II, 365.
[4] Hak. Soc. ed. Travels, 232, note.
[5] Hist. of Chile, ed. of 1808, I, 95.
[6] Voy. to Isth. of Am., 100.
[7] Hist. of Barbadoes, 79.

discerned at the distance of two paces; a crimson and scarlet mixt, the fruit about three inches long, and shines more than the best polished corall. The other, of the same color and glistening as much, but shapt like a large button of a cloak; both of one and the same quality; both so violently strong, as when we break but the skin, it sends out such a vapor into our lungs, as we fall all a coughing. * * * * It grows on a little shrub, no bigger than a gooseberry bush." In Jamaica, Long[1] says "there are about fifteen varieties of the Capsicum in this island, which are found in most parts of it. Those which are most commonly noticed are the *bell* pepper, *goat*, *bonnet*, *bird*, *olive*, *hen*, *barbary*, *finger*, *cherry*, &c. Of these the *bell* is esteemed most proper for pickling."

Capsicum annuum L., has never been found wild, but *C. frutescens* Willd. has been found wild, apparently indigenous, in South America. De Martius brought it from the banks of the Amazon, Poeppig from the province of Maynas in Peru, and Blanchet from the province of Bahia.[2] The form, *C. indicum* Rumph. = *C. frutescens* L., is said by Ainslie[3] to be constantly found in a wild state in the islands of the Eastern archipelago.

Capsicum annuum L.—According to Naudin *C. longum* DC., and *C. grossum* Willd., are not specifically distinct from this plant. It is said by Clusius to have been brought by the Portuguese from Brazil to India,[4] and reached England in 1548;[5] and is mentioned by Gerarde as being under cultivation in his time. The fruit is variable in form and color, as is also the plant. It was mentioned by Louriero (1790 or 1798) as a cultivated plant of Southern China, but has not been noticed by the Chinese writers of the sixteenth century or in others of more recent date, although nowadays much cultivated in China.[6] It is the *chilli* pepper of India, according to Firminger,[7] while Drury assigns the name *chilly* to *C. frutescens* L.

C. angulosum Mill. (1743).—Bonnet pepper of Miller. It is a variety of the preceding, and was described by Tournefort in

[1] Jamaica, ed. 1774, book III, chap. VIII, 721.
[2] De Candolle, Orig. of Cult. Pl., 290.
[3] Mat. Med., I, 306.
[4] Pharmacog., 453.
[5] Booth, Treas. of Bot.
[6] Bretschneider, On the study, &c., p. 17.
[7] Gard. in India, 153.

1700.[1] The name is the same as used by Long for one of his Jamaica varieties, and is perhaps one of the sorts described by Ligon, 1647–53, as occurring in Barbadoes, "shaped like a large button of a coat." The fruit is described by Miller as variable, some being bell-shaped, and Tournefort's name would imply a heart-shaped fruit.

C. baccatum L.—Bird pepper, according to Miller, and synonymous with *C. frutescens* var. L., *C. fructu minimo conico rubro* Brown, etc., and described among Jamaica plants by Sloane and Brown, in Amboina by Rumphius (1750), and as *C. brazilianum* Clusius (1601). It differs little from *C. frutescens*, and the berries are very pungent. *Bird* pepper is mentioned by name by Long in Jamaica, and by Wafer for the Isthmus; is perhaps the pepper "as large as haws" described in Brazil by Hans Stade. It has been in England since 1731,[2] and a "*bird* or *West Indian*" was in American gardens preceding 1828. It is mentioned as well known in India by Firminger and Drury, but I do not identify it with any of the present varieties of our seed catalogues. From an uncertain authority[3] it is said to grow wild from Southern Texas to Arizona, but it is not catalogued in the report on the plants of the "United States and Mexican Boundary Survey," 1858, unless it be synonymous with *C. microphyllum* Dun.

C. cerasiforme Mill.—Cherry pepper, also described by Tournefort, 1700. It was sent from the West Indies. It is probably one of the sorts described for Peru by Garcilasso de la Vega under the name *chinchi uchu*. It is also among the names listed by Long for Jamaica, and was in American gardens in 1806 or before. It is a variety of *C. annuum*, and the fruit is quite variable in form and color, some sorts being yellow. The form figured in Hortus Eystellensis, 1613, is precisely the cherry pepper of our gardens.

C. conoides Mill.—Came to Miller from Antigua under the name of *hen* pepper. This is a name which appears in Long's list of Jamaica sorts. The description of the fruit would answer to that of the oxheart of some of our seed catalogues.

C. cordiforme Mill., or heart-shaped Guinea pepper, was also described by Tournefort, 1700.[4] It has several varieties, the

[1] Miller's Dict.
[2] Booth, Treas. of Bot.
[3] Vick's Monthly, 1879, 184.
[4] Miller's Dict.

fruits varying in size, shape and color, some sorts bearing yellow. It can be referred to *C. annuum*, and seems to be the oxheart of some of our seedsmen.

C. fastigiatum Blume, syn. *C. minimum* Roxb.—It is the *C. frutescens* L. Spec. Plant., but not of L. Hort. Clif., to which the name *C. frutescens* is usually applied.[1] It occurs abundantly wild in Southern India, and is extensively cultivated in tropical Africa and America.[2] According to Miller it is *C. indicum* Rumph. (Amboyna), and the *Capo-molago* of Reede (Malabar) which fixes its presence in the East Indies about 1700. It is described by Loureiro, and was in England in 1656. It does not appear to be among the species grown in American gardens, all of which can be referred to *C. annuum*.

C. frutescens L.—This has been called *barbary*, *cayenne*, *shrubby* and *goat* pepper. It seems to have occurred in our seed catalogues under the name of True Cayenne, but does not appear to be cultivated with us now. It was in English gardens in 1656.[3] and seems to have been called *barbary* from the size and shape of its fruit, which are like those of a berberry. It seems to be cultivated and to have native names in Hayti, Peru, Mexico, India, Burma, Malabar, Ceylon, Yemen, Greece, Egypt, &c., and furnishes much pod pepper to commerce. It has been found wild from Bahia to Eastern Peru in tropical America.[4] In Ceylon a red, a yellow and a black fruited form are known.[5]

C. grossum Willd.—This is the pepper with large sweet square fruits, and furnishes many varieties and synonyms to our seed catalogues, and is considered to be but a form of *C. annuum*. It may be the *rocot uchu* of G. de Vega. It was, according to Miller's Dictionary, described by Besleri in 1613,[6] by Bauhin in 1671, and by Tournefort in 1700. *C. tetragonum* is a synonym by Miller, 1737. It was cultivated by Miller in 1759. According to Noisette[7] it reached Europe in 1548. It is called in Hindustani *kaffrie-murich*, and the fruit, as large as a small apple, is called by the English in India *coffrie chili*,[8] or, according to Fir-

[1] Pharmacog., 452.
[2] ib.
[3] Booth, l. c.
[4] De Candolle.
[5] Moon, Cat. of Ceylon Pl., 16.
[6] The type, but not our varieties in Hortus Eystellensis, (Besleri), 1613.
[7] Man. du Jard., 520.
[8] Ainslie, Mat. Med., 1, 307.

minger, *bell* pepper.[1] The squash or tomato-shaped, sweet mountain, sweet Spanish and many other similar varieties of our seed catalogues belong to this form, of which the first was in our gardens preceding 1828, as also this and the sweet Spanish in French gardens. There are red and yellow sorts, as in most of the so-called species. This is perhaps the *bell* of Long's Jamaica list, as he says it is esteemed most proper for pickling.

C. longum DC. is another form usually referred to *C. annuum.* It reached Europe in 1548,[2] or before,[3] and would appear to be the second kind, so much esteemed, of De Vega, and the one of the sorts referred to by Ligon as "resembling a child's corall." *Corail* is yet one of the names for this sort in France. It was grown in England in 1597 and before, as Gerarde speaks of it. There is a figure of it in Fuchsius' Historia Stirpum, Basle, 1542, under the name of siliquastrum or calicut pepper, and a statement that the plant had been introduced into Germany from India a few years previously.[4] It was in American gardens, by name at least, before 1806, and is the *long red* or *long yellow* of our present seed catalogues.

C. microphyllum Dun. is said by Torrey to occur in Western Mexico, Chihuahua, Nuevo Leon, etc., but he does not say whether cultivated or wild. The Mexicans call it *chipatane*, and use the fruit like other red peppers.[5]

C. nepalense Drury is a variety growing in Nepaul, and very pungent and acrid.[6]

C. olivæforme Mill.—A variety of *C. annuum*, and described by Miller in 1752, and by Tournefort in 1700. It came from Barbadoes,[7] and the name appears in Long's Jamaica list. It may be the sort which appears in our catalogues under the name of cranberry, but other kinds occasionally produce olive-shaped fruits.

C. sinense L.—This sort was described by Linnæus and Jacquin about 1770–76, the fruit yellow. It is cultivated in Martinique.[8]

C. tetragonum.—This is said by Booth[9] to be the *bonnet* pepper

[1] Gard. in India, 153.
[2] Noisette, l. c.
[3] 1542, Fuchsius.
[4] Pharmacog., 453.
[5] Report of the Bot. of U. S. and Mex. Bound. Survey, 152.
[6] Drury, III.
[7] Miller's Dict.
[8] Miller's Dict.
[9] Treas. of Bot.

of Jamaica. The name appears in Long's list, edition of 1774. *C. tetragonum* Mill., 1737, is referred by him to *C. annuum* L., and also to *C. grossum* L., to which latter form it appears to rightly belong. It is now cultivated under the name of *paprika* in Lower Hungary on a large scale, the fruit three and a half to five inches long and three-quarters to one inch in diameter.[1] As this is a sweet variety, it is probably *C. grossum*, which is a form with very variable fruit. The name *bonnet* pepper is used by Miller, 1743, for *C. angulosum*, as already stated.

C. violaceum Humb. is apparently a variety of *C. annuum*, but the plant more or less deeply violet-tinted, the fruit black-violet on one side and reddish-green on the other, but becoming red in ripening. It came from Spanish America, and is now an occasional inmate of our gardens.

The twenty-two named varieties grown during 1882 and 1883 at the New York Agricultural Experiment Station seem to belong to *C. annuum* L., and while we are not prepared to affirm that they all can be identified with one or the other of the above named species, yet we think there is probable identification sufficient to justify the conclusion that no strongly marked sorts have appeared during the five centuries of European culture. When we consider that the various kinds of peppers easily cross-fertilize, and hence the difficulty of keeping the sorts distinct, we are led to believe that many of the forms which have received specific description are true agricultural or form-species, sufficiently distinct at their first appearance by discovery to justify a conclusion as to a long antiquity, and as to their power of resisting change. The whole *genus* needs revision from an agricultural instead of a strictly botanical standpoint.

Potato.—De Candolle in his Origin of Cultivated Plants, says truly: "No one can doubt that the potato is of American origin." There are some interesting notes, however, which De Candolle has not used. Prescott in his Conquest of Peru,[2] says in 1526 Pizarro, at the Rio de San Juan, eat the potato as it grew without cultivation. This evidence is as conclusive as to its wild state as the one which De Candolle quotes from Gray, which "sufficiently proves its wild state in Chili, viz., that even among the Araucanians, in the mountains of Malvarco, the soldiers of

[1] Gard. Chron., Sept. 10, 1881,343.
[2] I, 248.

Pincheira used to go and seek it for food.[1] Prescott adds, on the authority of Xerez,[2] that along the coast of Peru he saw the hillsides covered with the potato in cultivation.

Pedro de Cieza de Leon, who traveled in Peru, 1532–5, says that the principal food of the Collao was potatoes, which "are like earth nuts."[3] John Hawkins, in his second voyage, 1564, says the potatoes at Margarita island, "be the most delicate rootes that may be eaten, and doe far exceede their parsenips or carets,"[4] which, if sweet potatoes be not meant, indicate their introduction to the island, as the context parsenips and carets shows. Captains Preston and Sommers, 1595, say at Dominica island "the Indians came unto us in canoes * * * * and brought in them plantains, pinos and potatoes,"[5] which indicates how potatoes and other victuals were taken aboard ships as provisions. Under the name *openawk* Heriot describes, in 1584, what is supposed to be the potato in Virginia, and of which De Candolle thinks there can be no doubt. This fact would seem to indicate that *potatoes* in our quotation meant potato and not the sweet potato. It is quite probable that Hawkins carried the first potatoes to Virginia, for in 1565, after relieving the famine among the French on the banks of the River May (St. Johns), he sailed northward toward Virginia, which name included the Carolinas and a large extent of coast at this time, and had this tuber aboard as he brought tubers from Santa Fé de Bogota on this voyage into Ireland, as has been currently stated, and we know not upon what evidence Miller and Sir J. Banks believes these tubers to have been the sweet potato. What renders the opposite view more tenable is the course that ships customarily sailed, this being to Virginia by the way of the West Indies; and as well by the fact that Virginia received the potato from the beginning of its settlement. It is mentioned by Heriot, 1584, as already stated; is noticed there again in 1609,[6] in 1648,[7] and again in 1649 under circumstances that can leave no doubt: "The West India potatoe (by much more delicate and large than we have here grow-

[1] Flora Chiliena, v, 74.
[2] Conq. del Peru ap. Barcia, III, 181.
[3] Travels. Hak. Soc, ed., 360.
[4] Sec. Voy. Hak. Soc. ed., 27.
[5] Hak. Voy., IV, 62.
[6] A True Decl. of Va., Lond., 1610, 13.
[7] A perfect Desc. of Va., 1649, 4.

ing) besides that it is a food excellently delicious and strongly nourishing, fixes himself wherever planted, with such an irradicable fertility, that being set it eternally grows."[1] We see here the distinction drawn clearly between the sweet potato described and the potato already under cultivation.

The argument that if the introduction by Hawkins into Ireland had been the potato, it would have secured dissemination, loses its force when we consider the slowness of its progress in England. It was certainly grown by Gerarde in 1597. In 1663 Mr, Buckland, of Somersetshire, drew the attention of the Royal Society to its value, earnestly recommending the general cultivation of the potato throughout the kingdom. In 1664 Forster recommends its cultivation in England. Ray, 1686, takes no further notice of the potato except by saying it is dressed in the same manner as Spanish batatas; Merritt, 1687, records that potatoes were then grown in many fields in Wales; Worlidge, 1687, describes potatoes as being very useful as "forcing fruits," and does not hear that field culture has yet been tried; Lisle, a little later, is wholly silent about the potato, as are also London and Wise, 1719; Mortimer, 1708, says the potato is not as good nor as wholesome as the Jerusalem artichoke, but that it may prove good for swine; Bradley, about 1719, says they are of less note than horse-radish, radish scorzoners, beets and skirrets, but as they are not without their admirers, he will not pass them by in silence. Other authorities to the same purport are given in Martyns Miller's Dictionary.

This reference to quality by Mortimer[2] is suggestive that the potato, until improved by European culture, was not the vegetable it now is for quality, and this poor quality it then may have possessed, may account for its slow progress, and even for its former recommendations for animals rather than for man, as by Worlidge above quoted, and Clusius says that the plant had become so common in Italy that it was eaten like a turnip and given to the pigs. Targioni does not, however, recognize this former wide cultivation in Italy, and says that it was only at the end of the sixteenth century or beginning of the seventeenth that the cultivation became known in Tuscany. In support of the theory that the potato was not as palatable in early times as now,

[1] Virginia by E. W[illiams], Gent., Lond., 1650, 48.
[2] Gard. Kalendar, 1708.

we may quote a few authorities. Miller, in 1754, says they were despised by the rich and deemed only the proper food for the meaner sort of persons. Mawe and Abercrombie, 1778, give caution as to their deleterious properties unless thoroughly well cooked. In 1830, in Watson's Annals of Philadelphia, it is written that a gentleman, "now in his 90th year, told me that the potatoes used in his early life were very inferior to the present. They were called Spanish potatoes, and were very sharp and pungent in the throat and smell. They send occasionally a better sort from Liverpool." In 1698 potatoes were scarce, Jerusalem artichokes abundant, in French markets.

Were a new root equal in edible quality to our snowflake potato and of the same ease of culture, now introduced, who can doubt its quick recognition and adoption? It would not be compared to the parsnip or carrot, as Hawkins did his potato, but would be described in glowing terms. We would not have its medicinal qualities under discussion, but would be satisfied to have it on our tables. If, however, we should now eat some of our poorer qualities of potato, such as were commonly grown for cattle a quarter of a century ago, we would see in the soggy and hard condition a root which might well have excited the admiration of Hawkins, and which would have suggested the parsnip or the carrot for comparison more than would a sweet potato.

(To be continued.)

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NOTES ON THE LABRADOR ESKIMO AND THEIR FORMER RANGE SOUTHWARD.

BY A. S. PACKARD.

(Continued from p. 481, May number.)

THE stone structures, particularly the grave or dolmen-like burial places referred to by the Moravians, are of course matters of very great interest. In connection with that statement we would draw attention to the following extract from "The three voyages of Martin Frobisher," second voyage, 1577, Hakluyt Society, London, 1867, p. 136:

"In one of the small islands here [near Lecester's Iland in Beares sound] we founde a tombe, wherein the bones of a dead man lay together, and our savage being with us and demanded (by signes) whether his countryman had not slain this man and eat

his flesh so from the bones, he made signes to the contrarie, and that he was slain with wolves and wild beastes."

Although it is generally stated that the Eskimo seldom if ever bury their dead, the foregoing statement would show that in early times at least they took pains to place the corpse in stone tombs. I found at Hopedale, in 1864, two skeletons, evidently Eskimo, interred in the following manner: while walking over a high bare hill north-east of the station I discovered a pole projecting from what seemed a fissure in the rock; it proved to be the sign of an Eskimo grave; the pole projected from the chasm, which was about fifteen inches wide and twenty or twenty-four inches in depth; the opening was covered by a few large stones laid across the fissure. At the bottom lay the remains of two skeletons entirely exposed to the elements, with no soil over them. The skulls were tolerably well preserved, and so were the long bones, but the vertebræ, ribs, &c., had mostly decayed. Judging by the way in which such objects are preserved in the open air on this coast, the burial must have been made at least over half a century ago, but more probably from one to three centuries since.

We now glean the following extracts from Hind's excellent Explorations in the Interior of the Labrador peninsula, which show that the Eskimo spread south-westward along the coast of Labrador as far as the Mingan islands.

Speaking of the Montagnais or coast Indians of Labrador, he writes: "Of their wars with the Mohawks to the west, and the Esquimaux to the east, between 200 and 300 years ago, there not only remain traditions, but the names of many places in the Labrador peninsula are derived from bloody battles with their bold and cruel enemies, or the stolid and progressive Esquimaux" (II, p. 11).

"The summit of the Great Boule, 700 feet above the sea, and the brow of the bold peninsula on the west side of the harbour [Seven Island bay] were two noted outlooks in the good old Montagnais times. They are not unfrequently visited now, when the Indians of the coast wish to show their country to the Nasquapees from the interior, and to tell them of their ancient wars with the Esquimaux. * * * They were able to hold their own against the Esquimaux in consequence of the almost exclusively maritime habits of the people, who rarely ascended the rivers further than the first falls or rapids: and they fearlessly

pursued their way through the interior of the country as far as the Straits of Belle Isle and Hamilton inlet, but exercising the utmost caution as they approached the sea to hunt for seals" (p. 30).

Of the Mingan islands Esquimaux island was so named "because the Esquimaux were wont to assemble there every spring in search of seals," &c., &c. (p. 49).

"The ruins of Brest must not be confounded with those of the old Esquimaux fort some distance farther up the straits, and which are found on Esquimaux island in St. Paul's bay. These ruins, consisting of walls composed of stone and turf, remain almost entire to this day;[1] and on the same island are large numbers of human bones, the relics of a great battle between the Montagnais and French on one side and the Esquimaux on the other, which were found about 1840" (p. 130).

"At Fox harbour there is a small settlement of Esquimaux, who are now orderly and industrious Christian people, fruits of the faithful labours of the missionary at Battle harbour, who has resided eight years on the coast" (p. 198).

"Seals have been the chief cause of the wars between the Montagnais and Esquimaux of the Labrador peninsula, and most of the conflicts between these people have taken place at the estuaries of rivers known to be favourite haunts of the seal" (p. 204).

Regarding the Eskimo living near Caribou island, at the mouth of Esquimaux river, Strait of Belle Isle, in 1860 and several years after that date, the following information has been kindly given me by the Rev. C. C. Carpenter, for some years (1858 to 1865) a missionary to this part of the Labrador coast: "Concerning the Esquimaux ('Huskemaw,' old father Chalker at Salmon bay used to call them), in my time there was only one family living in the immediate vicinity of the mission, and that only a fragment—the Dukes family. They once lived at the extremity of Five League point. The husband (George?) died and the wife married an Englishman, old Johnny Goddard. She was a full-blooded Esquimaux, and could kill a seal by imitating its appearance in dress and cry, just as quick as the next man, and a good deal quicker if the other was white! She died at a great age about the year 1879. I was on the coast, after an absence of fifteen years, in

[1] Robertson of Sparr point.

1880, and was told that she was about 100 years old, but I deemed that an exaggeration. Her sons were George and Andrew, both now dead of consumption. I buried George at Middle bay in 1862. Andrew died since we came away. He had visited Halifax and had had his photograph taken; I have a copy of it; it is, however, of a dressed-up man, not my old Esquimaux friend. Both of the sons were unmarried. A daughter of old Aunt Jenny Goddard had a daughter, I think by an American sailor. She was called Lucy Dukes, and (her mother dying) was adopted by Mrs. Goddard. I dare say you remember her there at Stick Point island; she was lame. She married little Johnny Goddard, nephew of old John, and they with several children occupy the island home. She said to me in 1880, "There's my Jenny, just look at her narrow features; you know Granny had a very narrow face!" And yet an old sailor once said that the old woman's face was as flat as a barn door!

"There was another family of Esquimaux, whose residence was at St. Augustine; I cannot recall the surname. I used to see one, 'Louis the Esquimaux.' My impression is that one only of that family was living in 1880, for I brought home Esquimaux dolls in full dress made by her. These I feel sure were all the remnants living in my parish, say for fifty or a hundred miles up and down the coast.

"The Esquimaux in Southern Labrador are a remnant. Once powerful there and numerous, they were defeated in a battle fought on Esquimaux island (at the mouth of the river) by the Indians (Mountaineers), and what few were left went northward."

We observed on Caribou island traces of Eskimo occupation in the form of a circle of stones, like that observed farther north near Strawberry harbor.

Along the coast north of Hamilton inlet are a few Eskimo, half-breeds and probably remnants. At Roger's harbor we took aboard as pilot to Strawberry harbor one Cole, a half breed, part Eskimo and part Englishman, who had an Eskimo wife and two three-quarters-breed children; his mother was an Eskimo. There were formerly a few Eskimo living in this region, but they had died off rapidly within a few years past; our pilot from the States, Capt. French, who had frequented this coast for many years, said that there was now but one Eskimo where there used to be twenty. Their disappearance seems due partly to that of

seal, fish, birds and other game, and partly to contact with the civilization of this coast, their close winter houses inducing consumption and other chest troubles; but whatever the causes, the race is rapidly fading away, going by entire families. Cole was intelligent and could read and write.

On our way to Strawberry harbor we were boarded by an Eskimo who paddled up to our vessel in his kayak. He had been living in the bay during the summer. The next day I landed on a little flat islet near our harbor, and found traces of recent Eskimo occupation. An Eskimo family had evidently been summering there in a seal-skin tent. The marks of their temporary sojourn were the circle of water-worn stones which had been used to pitch the tent, the feathers and bones of sea-fowl which had been shot or snared, scattered bones of the seal and other unmistakable signs of Eskimo occupancy and of Eskimo personal uncleanliness. While here we learned that some Eskimo were spending the summer on an island hard by, and we tried to find one to pilot us to Hopedale, but were unsuccessful. We, however, obtained one who had received some education and was then living ten miles up the bay with a Norwegian in the employ of the Hudson Bay company, his pay being fifty dollars a year.

The number of Eskimo on the Labrador penisula is estimated at 1400, but this is probably an overestimate, as most of this race are now partly civilized and gathered at the Moravian Mission stations of Hopedale, Nain, Okkak, Zoar and Ramah.

At the time I visited Hopedale, which was in the summer of 1864, in the expedition of Mr. William Bradford, the well known artist, the Eskimo population of that station was about 200. It was reported to us that during the preceding March twenty-four Eskimo had died of "colds;" while at Okkak twenty-one had died, and the same number at Nain. Thus over a tenth part of the native population at these stations had died of chest diseases in a single month. This high death rate may be the result of their partial civilization and less hardy out-of-door life, but their houses are not very different from those their savage ancestors inhabited. The missionaries have wisely not attempted to force upon them European standards of living as regards dress and houses, and their system of trading with them as well as teaching them does not appear to have been accountable for this rapid decrease. On the contrary, anthropologists as well as humanita-

rians are under obligations for the success these devoted Moravians have had in preserving on American soil this interesting people intact, unmixed, and with some of their harmless and more interesting habits preserved. They are, however, doomed, judging by the past years' experience, to ultimate extinction.

As regards the longevity of these people, we understood the oldest person at Hopedale, the patriarch of the colony, to be a woman of seventy years; we saw her, a picture of uglinesss which still haunts our memory. There were three Eskimo who were sixty years old. A man becomes prematurely old when forty-five years of age, as the hunters are by that time worn out by the hardships of the autumnal seal fishery.

The Eskimo settlement of Hopedale, the only one we visited, was founded in 1782. It consisted in 1864 of about thirty-five houses, arranged with more or less disorder in three principal streets. They are mostly built of upright spruce logs with the bark still on, dovetailed at the corners and banked nearly to the eaves with turf on the outside; the roof rather flat, though irregular, with a skylight and small window in one side, either as in the case of the more well-to-do families consisting of a rude sash with four or six glass panes, or panes of the intestines of the seal sewed together.

The house is entered through a long low porch, probably the survival of an ancient style, *i. e.*, the low porch of their snow houses through which their forefathers crept on their hands and knees. On entering we were obliged to stoop low and to circumspectly make our way between the carcass of a seal or a codfish, as the case might be, and a vessel of familiar, democratic shape and use, filled with urine, in which the sealskins are soaked before being chewed between the teeth of the housewife, an important step in the process of making or mending sealskin boots; while Eskimo dogs of various sizes and colors blocked the devious way.

Across the end of the interior, which was floored with wood, and in which we could not stand erect, was a wooden bed or seat, a sort of divan, on which sat a woman in spectacles weaving a basket of dried rushes which had been colored blue or red; she nodded a welcome and made us feel quite at home. The other belongings of the house were a hearth or fire-place of a few pebbles situated on one side, a soapstone lamp which was a

flat oblong dish, carved out of soapstone, of normal Eskimo design; some knives of European manufacture, needles and thread, while on a shelf we noticed an Eskimo Bible with the owner's name written in a neat hand on the fly leaf. On the whole the interior was neater and less offensive to the eye and nostril than we expected, as was the exterior. Besides the house, on a cross-pole supported by two uprights, rested a kayak, and over another horizontal pole hung drying a black bear's skin or dried cod-fish, as the case might be. The spaces between the houses were rudely drained, and saving the usual refuse heap at the rear of the house, a dog's carcass, fish bones and other rejectamenta, there was nothing particularly repulsive, though certainly nothing attractive about the houses. Two families sometimes live in the same house, which is partitioned off simply by a low rail passing through the middle. We do not remember seeing any babies, and there seemed to be few children compared to the adults; here as in the arctic regions the Eskimo having small families.

The women's dress differs from that of the Greenland Eskimo in the much longer tails of their jackets, which as seen in Pl. XVII nearly reach to the ground; by the Greenlanders it is worn but little longer than the men's; this difference, as seen on p. 473, was remarked by Cranch. Of late years woolen goods have partly superseded sealskin, but the pattern has been retained. Another difference is the form of the kayak; that of the Labrador Eskimo is much broader than the Greenland kayak, and of clumsier build, since the frame of the former is made of spruce; this renders the Labrador kayak perhaps safer.

So far as we could see the Labrador Eskimo at and north of Hopedale are full-blooded. Our engraving (Pl. XVII) is from a photograph taken by Mr. Bradford, and gives an excellent idea of a Hopedale Eskimo couple with their baby. The faces apparently show no trace of foreign blood, while there is said to be not a full-blooded Eskimo in the Greenland colony, the intermixture with the Danes and Scandinavians in general being thoroughgoing. Few Europeans or Americans had previous to 1864 visited the Labrador coast north of Hopedale, and there the race has been preserved in most cases intact, though there may now be an occasional intermixture with the Newfoundland fishermen, who now go as far as Nain.

As to the number and distribution of the Eskimo north of the

Moravian stations, we now have some definite information from Lieut. Gordon's report of the Hudson's Bay expedition of 1884. He says: "I cannot help thinking that their numbers have sensibly diminished, inasmuch as we found signs of their presence everywhere; yet except at Port Burwell, Ashe inlet and Stupart's bay, none were met with. About six miles south of Port Burwell [Cape Chudleigh] there are the remains of what must once have been a large Eskimo settlement, their subterranean dwellings being still in a fair state of preservation. At the present time, so far as I can learn, there are only some five or six Eskimo families between Cape Chudleigh and Nachvak.

"Along the Labrador coast the Eskimo gather in small settlements round the Moravian Mission stations; at these places their numbers vary considerably. Nain is reported to be the largest settlement, and its Eskimo population amounts to about 200 souls" (p. 16).

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THE INTER-RELATIONSHIPS OF ARTHROPODS.

BY J. S. KINGSLEY.

IN most of the schemes of classification in vogue to-day the Arthropods are divided into two groups of equal rank, the first being the Crustacea, the second embracing the Tracheata or Insecta. Having recently studied the embryology of Limulus, and finding it necessary to ascertain its place among the arthropods, the writer was led to compare, in a critical manner, the various groups. This led to somewhat unexpected views as to the various inter-relationships of the different "types" (if that word may be pardoned), and as the results may prove of interest, a short résumé is here presented in advance of the full article which will appear in the *Quarterly Journal of Microscopical Science* for October.

It might be stated here, parenthetically, that upon a large number of points regarding the arthropods, and especially the so-called tracheates, our knowledge is extremely deficient. For this reason some of the following account is merely tentative, the probability being in favor of the views here adopted.

First, we may take up the relationship of Limulus to the spiders. The view first suggested by Strauss-Dürckheim and lately so ably supported by Professor E. Ray Lankester, that Limulus is not a crustacean but an arachnid, receives full confirmation from the

development of the king-crab. The introduction of this form into this group seems to necessitate a new term for the whole, and I have adopted the name Acerata for the arachnids and the merostomes, in reference to the absence of antennæ. It is but a slight modification of the word Acera, used many years ago by Latreille for the spiders alone. The term Arachnida still retains its former significance.

As here limited, the Acerata may be defined as arthropodous animals with the body divided into two regions (cephalothorax and abdomen), the cephalothorax bearing six pairs of primitively post-oral appendages. The number of abdominal appendages vary, but four or more are modified for respiratory purposes; respiration being performed by gills, "lungs" or tracheæ, the homology between these three types of organs being easily traced. The genital ducts empty at the base of the seventh (first abdominal) appendages and paired segmental organs open, in the young, at the base of the fifth pair of limbs, but lose their excretory duct in the adult. The genital glands are branched and the branches communicate through numerous anastomoses. The liver is large and voluminous. The development is direct, no metamorphosis being introduced.

Some of these points may require explanation, and while I would refer the reader to the paper on the embryology of Limulus for details, I may here mention a few facts. My studies on the development of the gills of the king-crab when compared with those of Metschnikoff on the scorpion and those of Salensky on the spiders, show that the lungs of the one and the gills of the other are (as was suggested by Lankester) perfectly homologous. They arise as foldings at the base of appendages, occupying the same position serially in both Limulus and the scorpions. Leydig showed, some thirty years ago, that the tracheæ and pulmonary sacs of the spiders were homologous organs, and in later years the same has been pointed out by Bertkau and Macleod. One very important point should here be noted. In the spiders the stigmata or external openings of the tracheæ or pulmonary sacs never occur elsewhere than on the abdomen, and they always perforate the sternal plates. In the hexapods they occur in all parts of the body, and always on the sides and never on the ventral surface.

The so-called coxal glands or, as I regard them, segmental

organs, have only recently been known. Packard first found them in Limulus, and later Lankester made an exhaustive histological study of them in comparison with similar glands occurring in the scorpions. Neither of these authors were able to find any external duct. More recently Bertkau has found that in the young spider they open externally at the base of the fifth pair of appendages (third pair of legs), but this duct is lost in the adult. The studies of Mr. Michael on the coxal glands of mites are, so far as they go, confirmative. In Limulus I found that they arose as coiled mesoblastic tubes, closely comparable to the segmental organs of worms, and emptied in the young at exactly the same point as in spiders.

It seems to me that these various points show that the Acerata are more closely allied to the Crustacea than to the hexapods and myriapods with which they are usually classed. Lankester has shown from a study of Apus that all of the crustacean appendages are primitively post-oral, a fact which is confirmed by the study of the development of various forms. With this point settled it would appear that we have a perfect right to compare, within certain limits, the segments and their appendages of spiders and crustaceans. Tabularly arranged, the result would be somewhat as follows :

CRUSTACEA.	ACERATA.
I. Antennula.	Chelicera.
II. Antenna.	Pedipalpus.
III. Mandible,	Leg I.
IV. Maxilla 1.	Leg II.
V. Maxilla 2.	Leg III.
VI. Maxilliped 1,	Leg IV.

That this serial comparison is legitimate is shown by several reasons besides that given above. In the Acerata the series embraces all of the cephalothoracic appendages. In the Crustacea it stops exactly at the line of division between the so-called head and thorax of the tetradecapods as well as in the embryos of many other forms. A further point is interesting. In many of the lower Crustacea a pair of so-called shell glands occur which are regarded by Claus, Grobben and others as comparable to the segmental organs of worms. The outlets of these organs occur at the bases of the second pair of maxillæ, a position which the above table will show is exactly comparable to that of the outlet of the coxal glands of Limulus and the spiders. In many Crus-

tacea another pair of glands occur, the antennal or green glands which also appear to belong to the same series.

A further point is also to be mentioned. In both Acerata and Crustacea the genital ducts open at the base of a pair of appendages near the middle of the body, and although that exact homology is lacking as to position which is seen in the case of the segmental organs, still there is enough similarity to make one think that here, as well as in other forms, a pair of segmental ducts has become modified to subserve the purposes of the genital system.

Did space allow, these comparisons could be prolonged almost indefinitely, showing that while there is a general resemblance between the Acerata and the Crustacea, there exists a much closer one between Limulus and the arachnids. If we turn now to a comparison of the Acerata, or even the arachnids proper, with the hexapods, we are at once struck with the important differences between them; differences which prove that the two groups have but little in common, and that, so far as these two are concerned, the division Tracheata is an artificial and not a natural one.

We have already alluded to one important difference between the tracheæ in the two groups. A few other remarks may prove of value. Tracheæ are internal tubes for conducting air to the tissues of the body. They are not confined to the "Tracheata" but occur in some of the terrestrial Crustacea. This was first pointed out by Lereboullet in 1851 in the sow-bugs (Oniscidæ), and more lately it has been shown that these tracheæ which are developed inside the branchial lamellæ are lined with a cuticle which is raised into folds, comparable to the so-called spiral filament in the tracheæ of the hexapods. The inference to be drawn is that tracheæ in the arthropods are not of phylogenetic significance, but have arisen from a necessity of conveying air to the blood and tissues in an air-breathing form. The thickenings of the cuticular wall, whether spirally or irregularly arranged, are intended to prevent the collapse of an otherwise delicate tube.

In both spiders and hexapods there are developed from the hinder division of the digestive tract excretory organs which are known as urinary or Malpighian tubules. The writer holds that these are not to be regarded as indicating any especial affinity between the two groups, but like the tracheæ are produced by

environment; though it must be admitted that the reason why a terrestrial life should cause the development of these organs is not as easily explained as in the case of the tracheæ. In proof, however, of the point made, it may be stated that in those amphipods which like Gammarus and Orchestia are more or less terrestrial in habit, similar tubes are developed from the same portion of the alimentary canal, and further that their size and length is directly proportional to the more or less terrestrial habits of these forms. The same is apparently true of some of the isopods, though on this point our information is deficient.

Another point usually emphasized is the fact that in the Crustacea a biramose condition of the appendages occurs while this is not known in the "tracheates." The studies of Lankester on Apus have shown how this biramose condition arose, and the fact that frequently it is lacking in the Crustacea would tend to indicate that it might have existed in the ancestors of the "tracheates" and have been lost in the present forms. Even more important is the fact that such structures are not unknown in the "tracheates." They occur, as James Wood-Mason has shown, in the thysanures, and Patten has described a similar state of affairs in the embryos of the cockroach.

So far as our present knowledge goes we can say nothing as to the primitive position of the antennæ of hexapods; whether they be processes of the procephalic lobes somewhat like those of Peripatus or appendages which originally belonged to the post-oral series and which have moved forwards to a pre-oral position as have the similarly named appendages of the Crustacea. In the former case the differences in this respect between the hexapods on the one hand and the Crustacea and Acerata on the other will be seen to be very great. If the other view prove to be the true one, these organs of course will have less importance from a taxonomic standpoint. Still the differences will be very marked. That the former view is correct I am inclined to believe. If we accept it and regard the antennæ as something entirely represented in spiders and Crustacea and then make a serial comparison as before, the result is as follows:

Hexapoda.	Acerata.
I. Mandibles.	Chelecera.
II. Maxilla.	Pedipalpus.
III. Labium.	Leg I.
IV. Leg I.	Leg II.
V. Leg II.	Leg III.
VI. Leg III.	Leg IV.

This comparison brings the beginning of the abdomen in the same position in each group, but we have no other features to test its validity as we had in the case of the Acerata and Crustacea. In the hexapods there is nothing which in any way resembles a segmental organ.

The hexapods have no liver, an organ voluminously developed in Acerata and Crustacea; their genital ducts terminate at the end of the body, and no evidence as yet presented points to the conclusion that they are to be regarded as modified segmental organs.

With regard to the myriapods the problem is more difficult, and our knowledge of the development is too scanty to throw much light on the subject. The attempt has often been made to homologize the mouth parts in the two groups, but as yet with not very satisfactory results. A few morphological facts may prove suggestive. As is well known the myriapods are divided into two groups, Chilopoda and Chilognatha, represented by Scolopendra and Julus respectively. In the Chilopoda the genital ducts terminate at the end of the body beneath the anus, in the chilognaths near the anterior end of the body, in a position almost comparable to that in the Acerata. In the chilopods the stigmata occupy the same position (between the dorsal and ventral plates) as in hexapods, but in the chilognaths they may occur on the ventral plates or even in the bases of the legs. Apparently in both groups the antennæ are pre-oral in position; in the chilognaths their nerves arise in advance of those to the optic organs.

In this connection more knowledge, especially of the head, is desirable concerning the curious fossil myriapod, Acantherpestes, described by Mr. Scudder. Scolopéndrella will also repay investigation. In these forms, between the bases of the legs are the openings of peculiar organs. Mr. Ryder regarded those of Scolopendrella as tracheal stigmata; Mr. Scudder those of Acantherpestes as supports for branchiæ. It may turn out, indeed it is probable, that both are the outlets of segmental organs.

The few facts here presented, when taken together with the preceding remarks on tracheæ and Malpighian tubes, would allow the supposition that the myriapods may have but little relationship with either hexapods or spiders, and even that chilopods and chilognaths are not so closely connected as is usually supposed.

The discovery by Moseley of tracheæ in Peripatus at once transferred this form to the tracheate phylum, and much was expected from it as throwing light on the origin of the other air-breathing arthropods. To the writer it does not appear to have any close relationship to any of the other "tracheata," but still most of all to the chilognaths. Still it is not proven beyond a doubt that it is an arthropod at all.

The so-called antennæ are always pre-oral (as shown by Kennel in the embryo and Balfour in the adult), and receive their nerve supply from the procephalic lobes in advance of these nerves to the eyes; thus allowing one to compare them with the pre-oral appendages of worms. The tracheæ and stigmata are not metamerically arranged, the latter opening more or less irregularly over the surface of the body and legs. The legs themselves are not distinctively arthropodous, while the numerous segmental organs indicate, as has often been pointed out, a very primitive form. Indeed, one has but to imagine a Syllid worm to leave its natural element and take to the land, losing the setæ of its parapodia and developing claws at their extremities, losing its median antennæ and developing tracheal pits for respiration and salivary glands to moisten its food, and Syllis becomes Peripatus. The other changes would be few. It would still retain its lateral tentacles, its segmental organs, its peculiar sympathetic nervous system and many details of its digestive tract. In fact Peripatus, in the light of recent studies, appears nearer the polychætous annelids than to any of the arthropods unless possibly the chilognathous myriapods.

Recapitulating now the results of this hasty sketch, we arrive at the following conclusions: Peripatus has departed the least from the ancestral annelidan stock, the hexapods the farthest. These then will form the extremes of the series. The Acerata and Crustacea should be placed near each other, but which is the higher is a question. For instance, in the one only one pair of segmental organs remains, and these have lost their external ducts, while in the other group two pairs of these organs are functional through life. On the other hand, two of the post-oral ganglia of the Crustacea have moved to a prestomial position and have joined the supra-œsophageal ganglion, while in the Acerata but one ganglion has been completely transferred and this has not yet become wholly united with the ganglion formed

by the procephalic lobes. The position to be occupied by the myriapods can only be decided by further study.

As will be seen, the points requiring further investigation are many. We at the same time know more and less of the arthropods than of any other group of the animal kingdom, unless it be of the birds. The literature descriptive of the species of insects is enormous, but when one tries, for the purpose of exact comparison, to find out from books some of the simplest points of tracheate anatomy, he is met with only vague and generalized statements or with no information at all. It may be that further study will show that the conclusions reached above are founded on insufficient data, but we think it must be admitted that so far as Crustacea, Arachnida, Limulus and the hexapods are concerned, the points here made are well sustained by our present knowledge. What is especially needed is a more exact knowledge of the arthropodan brain. The papers of Newton, Dietl, Flögel, Brant and others are good, so far as they go, but unfortunately they leave many and the most important points undecided. The same may be said of almost every other point in arthropodan anatomy except the morphology of the appendages, and even on this point much work remains to be done.

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HOW THE PITCHER PLANT GOT ITS LEAVES.

BY JOSEPH F. JAMES.

OF the many curious plants which have been given to the world by America, the pitcher plants are among the oddest. They form a family which belongs entirely to the new world, where the species are widely dispersed. One of them is found in South America, one in California, while the others are natives of the Atlantic seaboard. A single one of these extends northwestward to Minnesota and British America. The feature which is common to these widely-scattered forms is the hollow leaf, making a sort of pitcher into which insects fly or fall or walk.

When a leaf departs as far from the normal shape as does the leaf of the Sarracenia, it is always interesting work to try to discover the causes which have lead to the divergence. To do this it is necessary to go far back in the history of the world and find an ancestral leaf from which it could have come. This necessitates the examination of the various allies and relatives of the

plants, for by so doing it is often possible to find the line along which they have descended. It seldom happens that all traces of this line have been destroyed. Here and there a faint or obscure mark gives a clue; one thing leads to another, until at last it becomes easy to trace the line of development to the original starting point. To do this it will first be necessary to give some account of the pitcher plants now living in the new world.

Fig. 1.

Fig. 2.

FIG. 1.—Leaf of Heliamphora.
FIG. 2.—Hairs of Heliamphora; *b*, from base; *a*, from top.

The simplest form of leaf in the family is found in Heliamphora, a native of Venezuela in South America. It is a hollow tube with a narrow opening extending nearly one-fourth the way to the bottom, and with a small rudimentary hood at the top (Fig. 1). Nearly the whole of the interior of the leaf is lined with hairs, those at the bottom long and slender, and those at the top short and thick (Fig. 2). They do not seem to be either

secreting or absorbing hairs, but serve simply to prevent the escape of insects which have once found their way inside. This may be regarded as the nearest living equivalent of the original and ancestral form, but even it has, of course, been greatly modified to suit altered conditions.

FIG. 3.—Leaf of *Sarracenia purpurea*.

Next in order, but a little more modified, comes the widely dispersed Side-saddle flower (*Sarracenia purpurea*) of the bogs of the Eastern and Northern United States. In this species the leaf forms a more perfect tube, open only at the top, and surmounted

on one side by an upright hood (Fig. 3), the inner surface of which is thickly covered with short stiff hairs, all pointing downwards. The interior surface at the bottom of the hollow is lined with slender bristles (Fig. 4). These extend about one-third of the way up. Then comes a perfectly smooth, glaucous surface, extending another third of the way, and above it is another set of hairs similar to those on the hood. In this leaf there is a marked advance in development

FIG. 4.—Hairs of *Sarracenia purpurea*; *b*, base; *a*, top.

over the first one. The hollow is more complete; the hood is larger and more conspicuous and attractive; the smooth surface at the center of the hollow is a more effectual safeguard against the escape of insects, and the plant is in every way better adapted to secure insect prey. Still the pitcher is open to the rain, secretes little or no nectar, and absorbs the juices of the insects it captures in the form of a liquid manure only.

The next step in advance is found in a southern species of the genus with larger and more upright leaves, known as *Sarracenia flava*. The arrangement of the hairs in the interior of the leaf is the same; but a saccharine secretion just below the hood shows a marked difference, and is a more effectual lure to insects than merely a colored surface such as there is in the species previously referred to. The provisions for the retention of insects are equally good in both species, but in the *flava* a secretion of honey acts as a bait. It seems to possess, too, a slight trace of a deleterious quality.

FIG. 5.—Leaf of *Sarracenia variolaris*.

The fourth round of the ladder is *Sarracenia variolaris* (Fig. 5), and here is found a wonderful advance in structure. In the first place the hood bends over the orifice of the leaf and shuts out all rain. Secondly, the hood is marked on the posterior portion with white translucent spots and reticulations, and honey is there secreted. Thirdly, the fine velvety pubescence extends one-third way down the pitcher, and then the hairs become longer, coarser

Fig. 6.

Fig. 7.

FIG. 6.—Leaf of Darlingtonia. FIG. 7.—Hairs of Darlingtonia; *b*, base; *a*, top.

and more bristly as the tube narrows. Fourthly, a secretion is formed at the bottom of the pitcher which has the peculiar property of asphyxiating insects so unfortunate as to fall into it Fifthly, there is found to be a honey-baited pathway running from the ground up along the wing of the leaf to the hood, and a short way into the orifice.

These are many and curious changes. A marked advance

over the open, honeyless pitcher of *S. purpurea* is at once manifest. But a still further advance is found in Darlingtonia, the third genus of the order and a native of California. In this the leaves are very long, stand upright and have a peculiar twist not found in any other species (Fig. 6). The hood, in addition, forms a vaulted arch, mottled with spots and reticulations. The only entrance to the leaf is from below, and on each side of this entrance is a long appendage, the whole likened to a fish tail. The inside of this secretes honey and is covered with hairs. The interior of the pitcher is lined with vast numbers of hairs, which become longer and more bristly toward the bottom (Fig. 7). A secretion is found here that has the power of decomposing the bodies of the insects which have been entrapped. On the outside, running along the wing, from the ground to the orifice, is a honey pathway which lures creeping insects to their destruction. The wings or fish-tail, at the top of the pitcher, attract flying ones.

In these species of plants there is a regular gradation from the simple to the complex. From the Heliamphora with its open pitcher and small hood, to the *Sarracenia purpurea* with upright, less open pitcher and larger hood; thence to the *S. variolaris* through several stages of less complexity, with its almost closed pitcher, power of secreting honey and digestive fluid; then to the more remarkable Darlingtonia, with its large twisted leaves, with vaulted hoods and fish-tail appendages, decomposing fluid and honey-secreting apparatus. Scarcely any of the steps showing the progress are needed to complete the line of development. It can be traced directly from Heliamphora to Darlingtonia, and it is only necessary to have an ancestral form from which to start to have a complete pedigree.

It seems probable that the water-lily family and the pitcher-plant family had a single ancestor in common. This ancestor was aquatic, or at least an inhabitant of swampy places. It had small, probably peltate, perhaps reniform leaves, and these had hollow petioles. The inner space was lined with hairs as are now the inner surfaces of the stems of Nymphæa and its allies; it had a four or five parted flower, with many stamens and a broad stigma.

From such an ancestor came two or three branches. One of these developed into plants having an aquatic habit, large leaves

and long petioles, and peduncles like those which are found at present in the water-lilies. The other branch diverged to form plants living in boggy or swampy grounds, with pitcher-like leaves whose insectivorous proclivities were developed later on.

The development of the members of the water-lily family from this hypothetical ancestor can be accounted for thus. The aquatic habit must be confirmed, the depth of water increased, the leaves grow larger and the change is complete. But to transform a peltate or reniform leaf into a pitcher requires much more modification. Suppose, however, that water lodging on the upper surfaces of some leaves was retained there; and that in this water insects were caught and drowned. Suppose the constant presence of the water caused the decay of the substance of the leaf at its insertion on the petiole and allowed the water to penetrate the hollow. This liquid manure might assist the plant in its growth. The habit of catching water by means of a peculiarly cup-like leaf, would be transmitted from generation to generation. Each successive one would have larger and larger petiolar spaces, and correspondingly smaller leaves. And this because the liquid manure supplied directly to the root would enable the plant to do with less and less leaf surface as the nutriment was more and more fully elaborated; until finally the petiole would have grown into a hollow pitcher-like affair, and the leaf-blade would have dwindled to a rudiment.

The primitive pitcher plant was probably but little less specialized than the least one now known. This one has already been described under Heliamphora. The various modifications of structure incident to change of form now come under consideration.

The internal hairs of modern water-lilies were likely represented in the ancient form from which they are descended. In species now living these hairs are stellate, with from three to five arms or projections (Fig. 8), and they thickly line the interior spaces of the petioles of leaves and the peduncles of flowers. Exposure to air and adaptation to altered conditions would naturally cause a change of form. They doubtless lost first one and then another

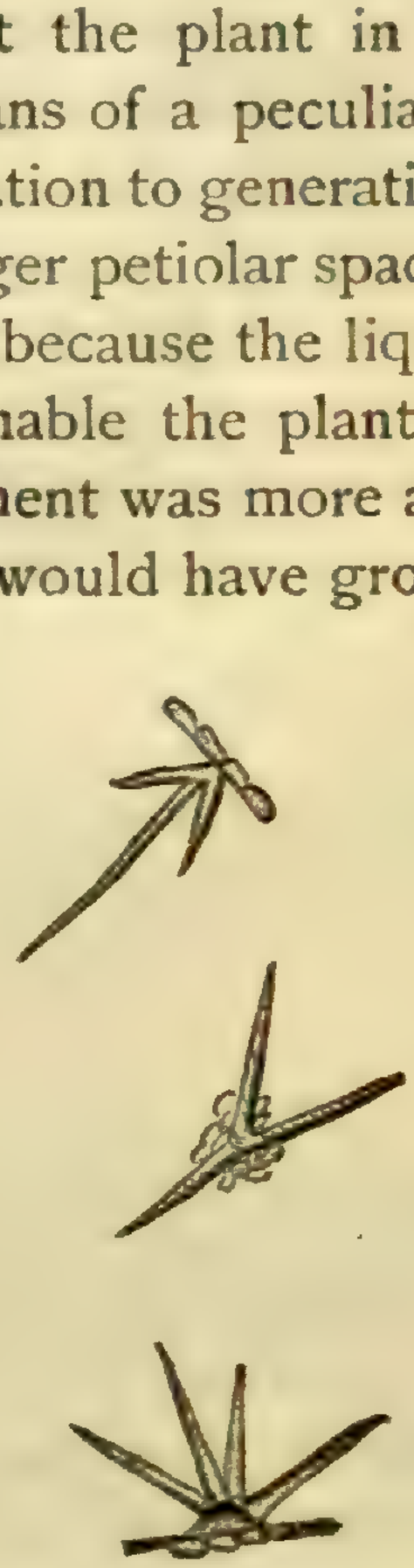

FIG. 8.—Internal hairs of water-lily.

projection, till they were reduced to a single one. This one would be, at first, of the same size and shape the whole length of the pitcher. Then, in time, as it was found that those at the bottom would not need to be so strong, they would become longer and more slender, while the uppermost ones would be stiff and harsh to more effectually prevent the crawling up of insects. As the specialization proceeded, a less number of hairs would be required and a smooth space near the center of the wall of the leaf would be found a still more effective guard against the escape of the prey.

FIG. 9.—Heliamphora.

As soon as the capture of insects became a necessary part of the existence of the plant, or even an advantage to it, honey would be developed to serve as an attraction. This, from at first a merely sweet secretion, would acquire, if it served a useful end, a character calculated to retain the insect. If, however, the honey had too bad an effect, the end in view would be defeated, for it would in time be rendered unattractive. For insects would in their turn, become modified to resist the temptation. So then the next step in the onward march would be to keep the honey of the lure pure, but to modify the character of the secretion at

the bottom of the pitcher so as to retain and eventually convert the insects caught into nutritious material for the plant. This secretion would become a further necessity, and its character would be otherwise changed when, by a change in the nature of the hood, rain was excluded from the cavity. Finally, as a further lure to insects appendages brightly or curiously colored would arise and assume a form calculated to attract them.

That these were the steps leading from the simplest to the most complex form of pitcher is shown in the actual forms living to-day. There can hardly be a better illustration of the theory of descent with modification than is found in this one family. It becomes, therefore, a matter of peculiar interest to still further continue the study, and to investigate the causes which led to the peculiarities of the flowers they possess, and likewise to study the reasons for their present geographical distribution.

FIG. 10.—Sarracenia.

The flowers of Heliamphora are described as being regular, with four, five or perhaps, at times, six sepals, no petals, an indefinable number of stamens, and a single, entire pistil (Fig. 9). There are one or two flowers on a bracted scape. In the flowers of all the species of Sarracenia a peculiar modification of the pistil is observed. Along with the five sepals and five petals, it is found that the pistil has assumed a broad, umbrella-like shape (Fig. 10) with the stigmatic surfaces at the ends of the rays. These are five in number and extend upwards as the flower hangs. A single flower is at the top of a naked scape. The flower of Darlingtonia (Fig. 11) is solitary at the top of a bracted scape, has five sepals and five petals, only twelve or fifteen stamens and a style with a five-rayed stigma.

In the first of these, the South American form, is probably to be found the nearest approach to the original type of flower. The single floral envelope, indefinite number of stamens and simple pistil, seem to indicate a comparatively unspecialized form, which corresponds to the simplicity of the leaves. In the modern Nymphæa or water-lily, there is a great number of petals, but these could be readily regarded as some of the numerous stamens of a few-sepaled or petaled flower which have been transformed into petals. In the ovary of Nuphar (spatter dock) there is an approach to the simple ovary of Heliamphora, accompanied, to be sure, by modifications which may be regarded as necessitated by an aquatic life. So that it does not require much to assume that in the flowers as in the leaves, the water-lilies and the pitcher plants are closely allied.

FIG. 11.—Darlingtonia.

The umbrella-like stigma of the side-saddle flower, as well as its whole arrangement, is to be regarded as a modification incident to cross-fertilization; for in these plants seed is not perfected otherwise. On this account alone it would be expected to diverge widely from the primitive form. But there is, in the closely allied poppy family, an approach to this spreading umbrella-like stigma, whose whole large expansion may undoubtedly be referred to the necessity for cross-fertilization.

Lastly, in the Darlingtonia the flower is also greatly modified. This time the change has taken place in accordance with changes in the leaves. The analogy between the fish-tail appendages of the leaves and the peculiarly spreading petals of the flower has been pointed out by Dr. Hooker. As both are of the same color and bear considerable resemblance to each other, he suggests that their development has proceeded together, and that while

one attracts the insects for purposes of fertilization, the other, by its imitative powers draws the visitor to it and is thus enabled to feed itself. Nor is such a suggestion an unreasonable one when the highly specialized condition of the plant is considered. If once a hint in that direction showed itself, and any benefit was thereby derived, it may be considered as certain that the direction would be persevered in until both leaves and flowers had departed very far from the original and normal type. This is exactly what has happened.

Coming finally to the geographical distribution of the order, the facts show plainly how one could have been derived from the other. The original home of all was most likely in South America, where one species still lingers. This original form may be imagined as conveyed from its place of origin to the south coast of what is now the United States, most likely by means of the Gulf Stream. Finding a suitable place for living, the somewhat changed conditions would have modified the emigrant into a plant with a leaf like *S. purpurea*. This once fairly established spread all over the country where there were favorable conditions for its growth. If we imagine this dispersion to have been during the continuance of the Tertiary period, there would have been ample time for great modification to take place. Then it was, in all likelihood, that the Darlingtonia began to develop in its own way. After a long period of time the Tertiary epoch was brought to a close. A great change came over the face of the country, and many of the intermediate forms between Sarracenia and Darlingtonia became extinct. Change in climate and in conditions produced by the glaciers which covered the country at one time was an efficient agent of extinction. At the same time the unextinguished forms would have continued to become modified in various ways until they became as they are now found.

The history of this one family, peculiarly circumstanced as it is, shows the possible origin of a number of forms from one common ancestor, different though they are from each other at present. In every part can be traced the workings of evolution. In leaf and in flower the steps can be followed. Even in the geographical distribution of the living species it can be seen. In some families of plants the steps are not so plain because encumbered by a larger number of generic and specific forms; but

could the gaps be filled in any one species or order, the line of descent might be followed through the ages to one common and generalized type. The varied forms to which that type gave rise are seen in the different genera of different natural orders. The time is far distant when all these can be traced step by step to their remote origin. But every little adds, and eventually a monument will be raised which will tell how, and perhaps when, each individual plant reached its present state of perfection or degeneracy.

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AN ADIRONDACK NATIONAL PARK.

BY WILLIAM HOSEA BALLOU.

A PROPOSITION to convert the Adirondack region into a national park, ought only to need suggestion. The only portion of the public domain which has been set aside as a national park is located in the distant mountain regions of Montana and Wyoming. East of the Rockies and within a territory of four million thickly populated square miles, not a single national breathing ground exists. In the great Empire State lies an elevated country of vast area, as lovely as the mind of man has mental imagery to conceive. It stands to-day the prey of timber thieves and game butchers, so neglected by the State that its boundary lines have been lost, its forests denuded, its waters left to evaporation and outrage, and its maintenance denied of all but the smallest pittance. It is the particular surface of the globe that gives one a glimpse through the corridors of time. It is a part of the cradle of the earth. Here are blue-gray hypersthene and contorted gneiss rocks—the first forms in nature's attempts at world building. Before organisms came into existence these rocks formed their part in the stable foundation of the earth. The Adirondack region, then, is grandparent to the remainder of the globe. The Hudson, which rises in its clouds, is perhaps the oldest river in existence, being the ancient outlet of the Great Lakes' ancestor, and hence the grandparent of waters. Will any one say that the Government of the United States ought not to be charged with the care of the portions of these aged relics which a great State has given over to weeds and bandits?

Two great watersheds lie within the State of New York at right angles to each other. They so interlock that writers have

been led to regard the State as one watershed. The dividing lines are too apparent, however, and the physical, climatic and geological differences necessarily form divisions of the State.

The eastern or Adirondack watershed runs almost north and south, throwing its waters north into the St. Lawrence, and south into Long Island sound. The western watershed runs nearly east and west, at right angles to the Adirondacks. It throws its waters from the interior chain of lakes, north into Lake Ontario. Its southern drainage flows at oblique angles into Chesapeake bay and the Gulf of Mexico.

The northern drainage of the western watershed occupies seven thousand square miles of territory, of which four hundred square miles are of lake surface, under the names of Oneida, Cayuga, Seneca, etc. This watershed has been made subservient to the necessities of commerce and industry. Besides being natural reservoirs, its lakes have been regulated to maintain a uniform flow through the Oswego river of six hundred thousand cubic feet of water per minute, during all seasons of the year. Seven dams on this stream, constructed by the state, provide hydraulic advantages equal to 140,000 horse-power. Thus the western watershed, by fostering gigantic industries, valued at millions, repays the State for the expenditure involved in its care.

The Adirondack watershed is of a different nature; its waters are of little commercial or industrial importance. Its rivers, the Moose, Beaver, Grass, Raquette, Salmon, Au Sable, Oswegatchie and others are high, turbulent and destructive in the spring. In the summer they are dry. The Hudson itself would be insignificant were it not an arm of the sea, scoured out and kept deep below Albany by the tides.

The Adirondack region has resisted all attempts at cultivation, otherwise it would be largely populated. Its mission is of higher importance to man than that of a mere industrial and commercial utility. Here is one of nature's great laboratories for the generation of pure air and the maintenance of stable atmospheric conditions. Its many cool lakes and babbling brooks form a natural resting and invigorating ground. It comprises the highest land in the State, ranging from one thousand to five thousand feet in elevation.

In this elevated domain are upward of two thousand lakes and lakelets abounding in clear cold waters—the ideal land of the

poet and the artist. The wild deer laves in the mirroring lake or lies sequestered in the deep ravine. The trout break the placid surfaces at night and the note of the whip-poor-will echoes from valley to peak through wood and clearing. The catamount watches from the creviced rocks and the black bear hibernates in the recesses of the forests. This is nature's miniature park of the earth. The mountains, cascades, rivulets, lakes and precipices are all scenic features in miniature. It is not a Yellowstone park. There are no three-mile vertical projections into space, no spouting geysers, no vast areas of sage brush, no great obsidian cliffs, no fossil forests, no bad lands of towering buttes and no bottomless cañons. All such awful sublimity is here molded in miniature—a playground of the gods.

Until the State survey began its work, ten years ago, but little was known of the Adirondack region. The only maps in possession of the comptroller were some curiosities made by colonial and early surveyors. So uncertain were the boundary lines that the State lost thousands of acres of lands, and was uncertain of any of its possessions. Investigation developed the fact that the State lands were first sold for little more than five cents per acre. The timber was immediately cut and the land allowed to lapse to the State for unpaid taxes. Wherever the second growth became valuable the lands were repurchased at tax sales, denuded and again left barren for the State, which now owns about eight hundred and ninety-five square miles. The watershed comprises about three thousand square miles which are available for park purposes.

The highest point in the State is Mt. Marcy, in Essex county, which rises 5344 feet above high tide. It is the monarch of the Adirondacks. Mt. MacIntyre, 5112 feet, approximates this altitude. Seventeen peaks exceed 4500 feet, forty-four rise above 3000 and seventy between that height and 2000 feet.

Mt. Washington, with its bridle-path and its inclined railway, has long enjoyed a monopoly in the East. A change is approaching. A new star has appeared in the sky. It is Mt. Marcy—nature's colossus to a noble name and the most ideal mountain on the face of the globe. It is no mere stone heap. Resting on its bosom are great forests, lofty spurs, precipices and lakes. Here also is Lake Tear-of-the-clouds, within one thousand feet of the summit—the supra-cloud source of the Hudson. It is the high-

est water in the State. The poetic State surveyor, Mr. Verplanck. Colvin, best describes it in these words :

" A few summers since I stood for the first time on the cool mossy shore of the mountain springlet lake, Tear-of-the clouds Almost hidden in the gigantic mountain domes of Marcy, Skylight and Gray peaks, this lovely pool lifted on its granite pedestal toward heaven, the loftiest water-mirror of the stars ; beseeching, not in vain, from each low-drifting cloud some tribute for the sources of the Hudson ; fresh, new, unvisited save by the wild beast that drank ; it was a gem more pure and delightful to the eye than the most precious jewel."

Mt. Marcy is the center of the scenic, sporting, artistic, poetic and scientific interest in the Adirondack region. The timber limit is here well defined at 4900 feet above the sea. The crevices are densely filled with stunted evergreen and the deep valleys between the mountain crests are covered with forests of pine, spruce, hemlock, beech, birch and other trees. Snows are almost perpetual here, summer lasting but two months. So far as may be judged by one who has visited each, there is little difference in temperature and climatic conditions between an altitude of 5000 feet on Mt. Marcy and 12,000 feet elevation in Wyoming. This similarity may be accounted for by means of the ameliorating influences of the Pacific coast on the Rocky mountains. Mt. Marcy is beginning to attract many visitors and is certain to draw heavily on the traveling public as soon as its grandeur and attractions become more generally known. It was seldom scaled until in 1875 the State survey projected a line of levels to its highest point. Since then there has been a gradual increase of summer visitants. The Indians called Mt. Marcy Ta-ha-wus, signifying " I cleave the clouds."

Observations tend to show a considerable decrease of rainfall in the State. This decrease has been attributed to the general denuding of forests in the Adirondacks. The iron industries alone have been shown to consume the wood on six thousand acres of land annually, to say nothing of the trees utilized as lumber. While no one of note has disputed the influence of forests on rainfall, such influence has not been satisfactorily explained. The following explanation is offered :

The Gulf Stream projects its waters along the Atlantic coast. It furnishes moisture to the winds which sweep over the land,

tempering the climate. Formerly when these winds beat against the Adirondack highlands there were vast areas of brush-topped evergreens and myriad-leaved trees to act as electrical conductors and precipitate moisture in the form of rain. The forests have been ruthlessly cut and now the moist winds beat against the rocks and burst in floods of water or in form of hail, or sweep past with their possibilities of evenly distributed rain. Nature takes her swift vengeance. The river bottoms show at the surface and the hurricane and hailstorm beat down the structures made of the forests. As Mr. Colvin states in one of his reports, the forests hold snow in compact depths which melts slowly, contributing a regular quota of water during three-fourths of the year. The cones fall from the evergreens, become pulverized and overgrown with moss. These cone beds hold water to such an extent that they were named "hanging lakes." Wherever the forests have been denuded the snow banks and cone beds have disappeared and thus, concludes Mr. Colvin, nature has been robbed of her reservoirs.

It seems incomprehensible that so great a commonwealth as New York has appropriated so little to maintain a survey of its own valuable possessions. No foreign government expends such a pittance for surveys of bergs, as the Empire State has for its entire area. The necessities of war, for which we must prepare in times of peace, demand the most minute and exhaustive surveys. The exchange of real estate, the prevention of needless lawsuits among citizens, and the taxation system, demand accurate surveys. The lack of good topographical maps may yet cost a thousand times the amount required for engineering. Instead of five thousand dollars occasionally, the State should have appropriated seventy-five thousand annually for this purpose.

The growing demand that the Adirondack region shall be set aside as a public park with liberal appropriations for its protection, superintendence and surveys has been met with little legislative encouragement, which so far only amounted to successive and expensive commissions since 1873. There is not a prairie State to-day that would not give millions for one Mt. Marcy. New Yorkers have migrated to every portion of the Union in great numbers. Had they a voice in the matter, the Adirondack region no doubt would be surrendered to the United States and cared for as jealously as is the Yellowstone park, with full appropriations for surveys and maintenance. If the proper steps were taken, there is little doubt that the consensus of opinion of the people would be in favor of such transfer, since the State of New York has shown itself incapable of caring for its possessions.

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The relations of the National Academy of Sciences to the Government deserve the attention of the scientific men of the country. There are two views of the nature and functions of this body. One of these is, that it is the advisor of the Government in such matters as come within its scope. As it is most likely to be called upon for opinions in questions of applied science, it follows that a considerable number of its members should represent that kind of ability, rather than advanced positions in original research in pure science. The other view is, that the academy is a body which includes a definite number of men who lead the progress of pure science in the country, irrespective of utility to the Government, and that as such, its membership constitutes an order of merit which is the highest within reach of the American scientist. From this standpoint its relations to the Government flow simply from the character of its membership, and not from any especial modification of its organization.

There is no reason why the two propositions above stated may not both be realized in the academy. This is doubtless the opinion of the large majority of its members, and indeed represents the actual state of affairs in that body. It is, nevertheless, easily seen that however combined, the two ideas are themselves distinct, and that care will always have to be exercised to preserve a just equilibrium between them. The fact that a large proportion of its members are in the employ of Government bureaus can excite no adverse criticism, and is indeed a necessary consequence of the large number of experts required for the Government service. But the academy must be protected against possible consequences of this fact.

In the interval between the annual meetings of 1884 and 1885, two members of a committee appointed to investigate a question affecting one of the bureaus of which they themselves are employees, were requested to resign from the committee by the chief of the bureau in question. This was in obedience to the rule that a department of the Government cannot be criticised by its subordinates. It requires no argument to show that if this rule be carried out with reference to the Academy of Sciences its usefulness as an independent body is at an end. There is also

another danger which flows directly from the same or a similar attitude on the part of heads of bureaus. These gentlemen, by filling up the academy with their employees can obtain practical control of its decisions. This would be immensely convenient to them under various circumstances, but it would introduce an element of corruption into the academy from which it has been hitherto happily free, and which would deprive it of the respect and confidence of the country. So long as the bureaus remain under the direction of their present heads, such contingency is remote; but changes for various reasons, political or otherwise, are by no means impossible. It is easier to provide against possible evils than to reform them when they are upon us.

—— The papers read at the late meeting of the National Academy of Sciences include several of first-class importance in systematic analysis. Such is the paper of Mr. Scudder on the palæozoic insects, and such that of Dr. Sterry Hunt on the classification of the natural silicates. Of the same character was the paper of Professor Gill on the orders of fishes; and to the same class belongs that of Professor Cope on the phylogeny of the placental Mammalia. These memoirs, if published in extenso in the next volume of the memoirs of the National Academy, will give it a value commensurate with the place the society holds among those of the country. Of almost equal but less comprehensive importance were the three papers read by Professor Packard on Palæozoic Crustacea, and by Professor Cope on the Pretertiary Vertebrata of Brazil. The papers in other departments were less important than is sometimes the case at the meetings of the academy.

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RECENT LITERATURE.

HAND-BOOK OF CENTRAL EUROPEAN FOREST ENTOMOLOGY.[1]— This promises to be a valuable contribution to forest entomology, especially as a text book in a school of forestry. This first part, now before us, is general in its nature, containing a brief biography of Ratzeburg, the leading authority on forest entomology, with a portrait; this is succeeded by chapters on the following subjects: The external form of adult insects; the internal structure of adult insects; reproduction and metamorphoses of insects; insects as natural and economic forces; the causes and remedies against destructive insects, and the economic compensations of the more extensive losses from the depredations of insects; general introduction to systematic and practical entomology.

[1] *Lehrbuch der Mitteleuropäischen Forstinsektenkunde, mit einem Anhange:* Die forstschädlichen Wirbelthiere. Als achte Auflage von Dr. J. T. C. RATZEBURG Die Walaverderber und ihre Feinde. In vollständiger Umarbeitung herausgegeben von Dr. J. F. JUDEICH und Dr. H. NITSCHE. I. Abtheilung, Ratzeburg's Leben, Einleitung, Allgemeiner Theil. Wien., E. Hölzel, 1885, 8vo., pp. 264.

The portion devoted in this work to the structure of insects seems to us too great, as there are good text-books on general entomology, but the physiological portions, especially those on the metamorphoses and reproduction of insects, are of immediate value to the practical observer. We miss full accounts with good illustration of the parasitic habits of ichneumons and Tachinæ. What is said of the influence of temperature, dampness and wind on insect life is valuable, as also the account of insect-destroying fungi, with the excellent cuts. While the work should give the student full theoretical knowledge it should emphasize all the facts leading to practical field work and observation.

CLAUS' ELEMENTARY TEXT-BOOK OF ZOOLOGY.—We have already called attention to the first part of this work, which has been translated by Sedgwick and Heathcote. The second part embraces mollusks, Tunicata and vertebrates, the spaces given to the last group being in our opinion too little; in such a book certainly one-half of the matter should be devoted to vertebrate animals. In point of treatment, and excellence of the illustrations the high character of the first part is well sustained in this the concluding part. The old meaningless group of Molluscoidea is, however, retained for the Bryozoa and Brachiopoda. To place these two groups of what may with safety be regarded as composite types of worms in a group equivalent in rank to the Arthropoda or Vertebrata shows lack of judgment. The author remarks in justification: "With the increase in our knowledge of their developmental history, it appears more and more probable, not only that the two groups are descended from an ancestral form common to them and the annelids, but also that in spite of the considerable differences between them in the adult state, they are in reality closely related, a supposition which agrees with the great resemblance of their larvæ."

The Tunicata are placed next to the vertebrates, above the mollusks and Molluscoidea, a position now seemed warranted.

The treatment of the Mammalia is, like that of the birds, antiquated, no reference being made to the new groups of extinct forms and the subsequent modifications which should be made in the classification of the class; besides, too little space is given to this most important of all classes of animals.

UPHAM'S FLORA OF MINNESOTA.[1]—The State of Minnesota is to be congratulated upon the appearance of so creditable a volume in its Annual Geological Report. The author has done a good work well and thoroughly, and has placed before the people of his State a work which will take rank as one of the best of its kind ever issued by the officers of a State survey. A good

[1] *Catalogue of the flora of Minnesota*, including its Phaenogamous and Vascular Cryptogamous plants, indigenous, naturalized and adventive. By WARREN UPHAM. Part VI of the annual report of progress [Geol. and Nat. Hist. Survey] for the year 1883. Minneapolis, Johnson, Smith & Harrison, 1884, pp. 193, with 1 plate.

map in colors shows the forest and prairie areas, and the distribution of the principal timber trees.

The total number of plants, including species and varieties enumerated in this catalogue is 1650, belonging to 557 genera and representing 118 natural orders. The series are distributed as follows:

Dicotyledons	1141
Monocotyledons	427
Gymnosperms	14
Pteridophytes	68

The catalogue is sent out as a report of progress, and the hope is expressed that it will incite all workers in the field to increased efforts. The final report is to include the lower groups of plants as well as the higher.—*Charles E. Bessey.*

Recent Books and Pamphlets.

Forbes, S. A.—Description of new Illinois fishes. Ext. Bull. Ill. State Lab. Nat. Hist., Jan., 1885. From the author.

Packard, A. S.—On the embryology of *Limulus polyphemus*. III. Proc. Amer. Philosophical Soc., May, 1885. From the author.

Böckh, J.—Brachydiastematherium transilvanicum Bkh. et Maty. Ein neues Pachydermen aus den eocänen Schichten Siebenbürgens. Budapest, 1876. From the author.

Moseley, H. N.—Notes on the structure of Seriatopora, Pocillopora, Corallium and Tubipora. Ext. Quart. Jour. Mic. Soc., 1882.

——On the pharynx of an unknown Holothurian of the family Dendrochirotæ, in which the calcareous skeleton is remarkably developed. Ext. idem., 1884.

——On the presence of eyes in the shells of certain Chitonidæ, and on the structure of these organs. Ext. idem., 1884.

——Address to the biological section of the British Association, Montreal, 1884. All from the author.

Dawson, G. M.—On the superficial deposits and glaciation of the district in the vicinity of the Bow and Belly rivers. Ext. Rep. Geol. Surv. Canada, 1882–84. From the author.

Lydekker, R.—Catalogue of the fossil Mammalia in the British Museum. Part I. London, 1885. From the author.

Dollo, L.—Rhinoceros vivants et fossiles. L'origine des Mammiferes. Les Labyrinthodontes, etc. Ext. de la Revue des questions Scien., Jan., 1885.

——Première note sur le Simœdosaurien d'Erquelinnes. Ext. Bull. du Musée Royal de Belgique, 1884. Both from the author.

Gaudry, A.—Nouvelle galerie de Paléontologie. Mus. d'Histoire Nat., Paris, 1885.
——Nouvelle note sur les reptiles permiens. Both from the author.

Boehm, G.—Beiträge zur Kentniss der grauen Kalke in Venetien. Berlin, 1884. From the author

Mus. d'Hist. Nat. Paris—Rapports annuels de MM. les professeurs et chefs de service, 1882.

Lundgren, B.—Undersökningar öfver Brachiopoderna i Suerges Kritsystem. Ur Lunds Universitets Arsskrift, 1885. From the author.

Trouessart, E. L., et Megnin, M. P.—Monographie du genre Freyana Haller, et description des espèces nouvelles du musee d'Angers, 1885. From the authors.
——Les sarcoptides plumicoles ou analgésinés. 1re partie, Les Ptérolichés, Paris, 1885. From the authors.

Claus, C.—Elementary textbook of zoölogy. Translated by A. Sedgwick and F. G. Heathcote. 2 vols. New York, Macmillan & Co. From the publishers.

Terry, S. H.—Controlling sex in generation. New York, 1885. Fowler & Wells Co. From the publishers.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*Kilima-njaro.*—The account given by Mr. H. H. Johnston, before the Royal Geographical Society, of his stay at Kilima-njaro, adds more to our knowledge of the zoölogy and botany of the southern slopes of this great mountain than to its geography. The vegetation is luxuriant, trees ascend to nine or ten thousand feet, herbaceous vegetation is abundant up to 13,000 feet, and heaths and some shrubs linger to above 14,000 feet. The buffalo, koodoo and elephant appear to ascend even to the snow-line. Mr. Johnston saw the footprints of buffaloes at 14,000 feet, and came in sight of three elephants at 13,000 feet. A hyrax ascends to 11,000 feet. In the discussion which followed, Mr. Thomson described Kilima-njaro as an enormous mountain mass, some sixty miles long by thirty wide, upon the summit of which the great dome of Kibô and the peak of Kimawenzi were comparatively small excrescences. On the southern side the country of Chaga was formed of a series of terraces of fertile land, but on the northern side the mountain rose at an even angle from 3000 to 18,000 feet without a break by ridge or valley.

The Egyptian Sudan.—Colonel H. G. Prout, an American engineer, formerly under the employ of General Stone, has contributed to the *Engineering News* an account of the route from Suakin to Berber. This is of interest geographically from the light it throws upon the nature of the country, which from immediately behind Suakin to Wady Ariab, 118 miles from that place, is mountainous, the projected road passing, at about sixty miles from Suakin, through a defile 3000 feet above the sea. The map recently compiled from data furnished by the office of Naval Intelligence, shows this route, as well as those between Massowah and Kassala, and Korosko and Abn Ahmed. Gen. C. P. Stone contributes to *Science* an account of the climate of various parts of the vast region known as the Egyptian Sudan. From November to February inclusive, the province of Dongola is healthy, but in the spring months the heat is excessive, dust storms violent, and fever prevalent. The moist winds of early autumn increase the unhealthiness. At Suakin, the intense heat is the chief foe to health; but the province of Taka (capital, Kassala) and the district of Gallabat have, from June to October, a climate which is deadly to Europeans. At that season the rains are copious, and mingling with the floods of water coming down from the mountains of Abyssinia, cause the rich soil to become like a saturated sponge. Even the natives, in many districts, abandon the country from May to October, and reside in the desert.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Asia.—*The Lower Helmund.*—The valley of the Helmund, at the point where it was struck by the Afghan boundary commission, below its junction with the Argandab, is narrow and limited by ranges of rolling clay or sandstone hills. Beyond these ridges rise other similar ridges, forming the *dashts*, or rolling plateaux of Southern Afghanistan. This desolate country is full of ruins. "From Lundi to Kala Fateh," writes Major Holdich, "one rides through and over the relics of dead kingdoms. The remains of forts, of deep-cut irrigation canals, of pretentious habitations which might have been palaces * * * are the common features of the landscape. Broken pottery strews the ground sometimes for miles at a time." All are built of mud or sun-dried bricks. During the whole of its lower course until it disappears in a hamun or swamp, it receives no tributaries. About Nadali are innumerable mounds, some of which, though always bearing ruins on their summit, are clearly stratified, and are therefore thought to be natural.

Discovery of the Sources of the Hoang-Ho.—The proceedings of the Royal Geographical Society for March contain translations of two letters sent by Col. Prejevalsky to the *Invalide Russe.* This intrepid traveler left Urga (a town in Northern Mongolia, situated on a branch of the Angora and south of the Irkutsk) on Nov. 8, 1883, and soon reached the vast desert of Gobi, which measures 2650 miles from east to west, and about 700 from north to south. The northern part of the desert is still a steppe region covered with excellent grass; but Central Gobi consists of perfectly bare flat spaces covered with pebbles and cut up at intervals by lone stratified ridges, while Southern Gobi is covered all over with quicksands, the remains of shoals and dunes of the once wide Central Asian sea. Terrible frosts in winter, without snow, and almost tropical heat in summer, with frequent storms, characterize this barren, rainless, riverless region; yet every part of it is inhabited by Mongols. Crossing the Khurkhu ridge, forming the eastern edge of the Altai, the southern desert, or Alashan, was entered, and a stay was made at Din-yuan-in, where the Alashan range runs like a wall between the desert and the cultivated banks of the northern bend of the Yellow river. Crossing the Nan-shan range, part of the unbroken wall which stretches from the Upper Hoang-ho to the Pamir, Col. Prejevalsky then entered Kan-su, and prepared to go in search of the hitherto undiscovered sources of the Hoang-ho. On his way he passed the plateau of Lake Koko-Nor, 10,800 feet above the sea; and then crossed the ridge of Burkhan-Buddha by a pass 15,700 feet above the sea. The circumference of Lake Koko-Nor is given as 166⅔ miles. Sixty-seven miles from the pass the sources of the Yellow river were reached. Two streamlets, flowing from the south and west, out of the mountains scattered about the plateau, unite at an elevation of 13,600 feet. The infant river is fed by the numerous springs

of the wide marshy valley (40 miles by 13½) of Odontala, or, as the Chinese call it, Sing-su-hai, or Starry sea. After a course of about fourteen miles, the river falls into a lake, the southern shores of which it colors with its muddy waters, then pouring out of it to the east it soon enters another lake, which it leaves a considerable river; further on, after making a sharp turn around the snow-covered ridge of Amne-machin, its mad current tears through the cross strata of the Kuen-lun and flows toward China proper. After this our traveler went southward, but was stopped by the unfordable Blue river, or Di-che (Yang-tsze), and returning northward, made his way to Zaidam, after two serious encounters with Tangutan robbers.

Asiatic Notes.—M. Donbrof has explored the upper course of the Selenka, and reached the hitherto unvisited source of this great tributary of Lake Baikal.——According to Mr. Gowland, who has recently crossed the central range of Corea during a journey from Sôul to Fusan, there are in this part of the peninsula no mountains above about 4000 feet in height, no characteristic volcanic cones, and no indications of mineral wealth. The resources of the country appear to lie entirely in agriculture.——M. Jos. Martin has arrived in Japan after a most arduous journey from the Lena to the Amoor, across the Stanovoi range of mountains.——Dr. Gustave Le Bon is traveling in Nepaul. He is said to be the first European who has been permitted to travel through that country.

AUSTRALASIA.—*The North Coast of New Guinea.*—Mr. Robidé van der Aa has recently published an account of two voyages to the north coast of New Guinea. In the first, the Mapia group of islands was visited, and the voyagers afterwards landed on Jamma, an island in Walckenaer bay, and a depot for the cocoanut fiber of the main land. About twenty-five miles south-east of Jamma is the mouth of a river, the Witriwaai, not found on any map. This was ascended to a large lagoon. About eight miles to the east is the Wiriwaai, with a strong current discoloring the water far out to sea. Sadipi bay, nearly a degree further east, is a deep and safe harbor. The houses here have at each gable end a pent-house roof, which comes so low that a hole is made to enable the occupants to crawl in. On the second voyage, the Amberno river was ascended for over sixty miles, when it shoaled, with a current of four and a half miles an hour. Mr. van der Aa argues from the size of this river (it is eight hundred yards wide) that it has a long course from the interior, cutting its way through the Rees mountains. Thus its upper waters may be navigable.——Dr. R. von Lendenfeld has found that Mount Kosciusko is not the highest of the Australian alps. He has ascended a higher peak at some distance farther south. This is 7256 feet high, while Mount Kosciusko has been measured at from 7171 to 7176

feet. The newly enthroned peak is named Mount Clarke. The upper limit of trees upon it is 5900 feet. Above 6500 feet patches of snow are found on the lee side of the main range, at 6500 feet.

AMERICA.—*Science* states that several expeditions to Alaska are projected during the coming season. Gen. Miles, who commands in the military district, desires to acquire a knowledge of Cook's inlet and the Tananah course and watershed, and it is hoped that a party under Lieut. Ray will be sent for the purpose. The party under Lieut. Abercrombie were unable to pass beyond the glacier alleged to obstruct the Copper or Atna river, about sixty miles from the sea. A party under Lieut. Allen left for the Copper river, June 30, and hope to cross the divide between that river and the Yukon basin and descend the latter. Lieut. Stoney is reported to have a new expedition nearly organized to continue his investigations of the Kowak river.

EUROPE.—M. Rabot has explored Lake Enara and the valleys of the Pasvig and Talom, in Finland. The country is an immense forest, with lakes and peat bogs scattered everywhere, and the only means of communication is by rivers which abound in cascades and rapids. Lake Enara, drained by the Pasvig, is a veritable inland sea, with hundreds of islets covered with magnificent pine trees. The country around it, level and little broken, forms a depression between the plateau of Finmark and the hills of Russian Lapland.

GEOLOGY AND PALÆONTOLOGY.

THE ORIGIN OF FRESH-WATER FAUNAS.—Professor W. J. Sollas gives to the world, in No. v, Vol. III, of the Scientific Transactions of the Royal Dublin Society a review of the causes which have originated and limited the fresh-water faunæ of the world. Three causes are admitted as proven: (1) the difference in chemical composition of the medium; (2) the severe character of the fresh-water climate; (3) the necessity for the suppression of a free larval existence. Although the first cause is doubtless a powerful one, it is not sufficient to alone account for the facts, as seems to have been too generally assumed, for in three months Beudant brought several species of marine mollusks to live in fresh water, and, though he failed with three species out of fifteen, it is probable that an unfailing supply of appropriate food and greater slowness in change of medium are the only conditions essential to the success of such experiments. Von Martens (*Ann. and Mag. Nat. History*, 1858) was the first to call attention to the climatic extremes suffered by animals resident in fresh water. Freezing limits them in the colder zones, while, though the populousness of the fresh waters increases towards the tropics, partial desiccation is a hindrance there. Yet, were the want of saltness

and the severity of the climate the only obstacles, we might expect that many more of the forms which crowd the coasts would work their way up the rivers. As a rule, however, the fresh-water forms are quite distinct from the marine, retain their distinctness everywhere, and, in time, are well marked as far back as the Mesozoic. It is therefore probable that the fact that the majority of marine invertebrata are diffused by means of free-swimming larvæ has been one of the chief obstacles to their spread up the rivers. These fragile and feeble larvæ always swim along with even an ocean current, and are utterly powerless to stem that of a river. Should a slow-moving marine animal succeed in ascending some distance up a stream, its larvæ, if free-moving, would infallibly be carried out to sea. By a detailed examination of the forms which inhabit fresh water, Professor Sollas shows that in most of them the free larval stages are suppressed. Other causes may exist. Thus the absence of suitable food is sufficient to account for the lack of carnivorous gastropods and cephalopods in the rivers.

Fresh-water animals may be converted into marine in three ways: (1) by direct migration; (2) by the conversion of the area they inhabit into a fresh-water basin or lake; (3) by adaptation to a terrestrial or marsh-loving habitat, and subsequent exchange of this for a fluviatile or lacustrine one. The first method can scarcely occur with fixed forms, unless they are parasitic upon locomotive animals. Some prawns and crabs appear to have thus immigrated by compliance with the three conditions, but the instances are very few. The wide changes in the distribution of land and water that have taken place in the course of geological time offer a more probable mode of the gradual transformation of a fauna from a marine to a fresh-water one. The comparative poverty of the latter may be due to the escape of some species, as well as to the extinction of others. The earliest lakes known are of the Devonian period, and one Devonian fossil at least, *Anodonta jukesii*, has been found. Helicidæ are found in the coal measures, and are probably the ancestors of the Limnæidæ. In the Lias and Oölite numerous fresh-water mollusks occur, and Cyrena, Neritina and Hydrobia probably date from the Trias. Several genera of fresh-water mollusks were already distributed over parts of the Palæarctic, Nearctic and Oriental regions in Cretaceous times. The Tertiary lakes of the northern hemisphere have suffered from a glacial era, and the Caspian has become unwholesome by concentration of its waters, yet it retains a relic of a Tertiary fauna; while the Central African lakes have a remarkable assemblage of Mollusca.

No marine mollusk is known to pass through a "glochidium" stage, like that of the Unionidæ; no marine Polyzoön or sponge produces statoblasts; no marine Phyllopod an ephippium; and no Tubularian an egg in a horny shell like that of Hydra. All

these are modifications suffered by fresh-water genera, are not shared by their marine relatives, and appear to be necessary to the existence of sedentary forms, as characteristic of fresh-water organisms. The wide distribution of a form introduced by floating timber is not probable until its developmental history has changed also.

THE BATRACHIA[1] OF THE PERMIAN BEDS OF BOHEMIA, AND THE LABYRINTHODONT FROM THE BIJORI GROUP (INDIA).[2]— In these contributions we find important additions by eminent palæontologists to the knowledge of the stegocephalous Batrachia of the regions named. In Dr. Fritsch's volume we have the continuation of an extensive work which we have noticed at various times in the NATURALIST as the successive parts appeared. We have to add, on this occasion, our renewed commendation of the care and detail with which Dr. Fritsch continues to develop the subject, and our praise for the admirable plates which accompany the text. The species treated of are those which belong to the larger forms of the Rhachitomi, together with some of the intermediate types, such as the Dendrerpetonidæ. Of the greatest interest are two new genera of the order Embolomeri, Chelydosaurus and Sphenosaurus, where the additional vertebral centrum, entire in the type of the order (Cricotus), is divided into three segments, two lateral and an inferior. This is a curious discovery, especially as Sphenosaurus has hitherto been regarded as a reptile.[3] It also has an important bearing on the value of the order Embolomeri, which Dr. Fritsch is disposed (p. 4) to question. He thinks that the embolomerous vertebral structure is confined to the caudal region in the genus Cricotus, although I have figured it in the lumbar and cervical region of that genus, and described it as found in the dorsal[4] region. Dr. Fritsch reached this conclusion because he finds that in Archegosaurus the caudal region is embolomerous, and the dorsal region rhachitomous. His discovery of the persistence of the embolomerous condition in the dorsal region of Chelydosaurus and Sphenosaurus might have suggested to him the correctness of my observations on Cricotus. I add here that in Eryops, in which the dorsal vertebræ are rhachitomous, the caudal vertebræ are not embolomerous. So Archegosaurus stands alone in this respect. This determination of the characters of Archegosaurus by Dr. Fritsch is very useful to American palæontologists, as it has hitherto been very imperfectly described. I have stated that there are vertebræ of this type

[1] Fauna der Gaskohle in d. Kalksteinen d. Permformation Böhmens. Von Dr. Anton Fritsch, B. II, Heft I; Praag, 1885.

[2] The Labyrinthodont from the Bijori group. By R. Lydekker, Mem. Geological Survey of India, Ser. IV, Vol. I, 1885.

[3] These two genera should form a second family of the Embolomeri, characterized as above, which I call the Sphenosauridæ.

[4] Proceedings Amer. Philosoph. Society, 1884, p. 29.

from Leybach in the museum of Princeton College, New Jersey. As they agree exactly with Dr. Fritsch's figures of Archegosaurus, it is difficult to perceive why he denies the accuracy of my statement in the matter (p. 15).

Both the authors here reviewed have evidently been more or less influenced by Mr. Miall's system of the Stegocephalous Batrachia—Dr. Fritsch adopting his names and Mr. Lydekker using his characters in defining his genera. We cannot but think that the publication of this system was a misfortune to the progress of the subject. The characters of the relative position of the eyes and nostrils and the outline of the skull are certainly only specific characters, and the veriest tyro in the study of recent Batrachia would not use them for generic characters, still less for family characters, as is done by Mr. Miall.

Dr. Lydekker's paper introduces an undoubted member of the order Rhachitomi to the Indian Permian fauna, and devotes his usual care to the description and illustration of it. Unfortunately the skull of the single specimen at his disposal has lost the bones of its superior face, so that many of the characters of the species and genus remain unknown. The latter, indeed, to which is given the barbarous name Gwandanosaurus, is not so defined as to be distinguishable from some of those already known. In view of its possibly turning out to be identical with some of these, Dr. Lydekker remarks that he relies on the spirit of the following rule of the International Geological Congress of Bologna "in favor of his own name," *i. e.*, "In future for specific names priority shall not be irrevocably acquired unless the species shall have been not only described but figured." This is a doctrine which if allowed, will be adopted very much on the principle of whose "ox is gored," and will work unfavorably at times against a good many names of Dr. Lydekker's A proper knowledge of the subject, and skill in systematic analysis, while never rendering illustrations unnecessary, are much more important than they to the real advancement of science.

Examples of the disregard of the law of priority in this paper are seen in the proposition that the name Actinodontidæ supersede Eryopidæ of prior date, and the use of the term hypocentrum for intercentrum of prior date. This we hold to be simply creating confusion, and causing much inconvenience to the student.[1] Moreover, Dr. Lydekker has not read the paper which he quotes. He states (p. 7) that the intercentrum of Cope is the pleurocentrum of Gaudry, and the centrum of Cope is the hypocentrum of Gaudry. The fact is the reverse. The intercentrum was renamed hypocentrum by Gaudry, and the centrum of Cope

[1] The same untenable method is evinced in Dr. Lydekker's rejection of the name Creodonta (1875), and the proposition to use in its stead the inconvenient expression "*Carnivora primigenia*" (Catalogue of Fossil Mammalia in British Museum, 1885, p. 20).

was called pleurocentrum by Gaudry. I have since adopted the latter term as a convenience, though this is not always true of the multiplication of names.—*E. D. Cope.*

THE GENERA OF THE DINOCERATA.—Professor Marsh's work on this order of mammals, just issued, supplies some important data as to the characters of some of the species described by him. I can now discriminate more clearly the generic characters, which are, I think, as follows :

Four bilobed symphyseal teeth on each side; inferior canine teeth not enlarged; inferior premolars three.....*Loxolophodon* Cope.

Four symphyseal teeth on each side, at least some of which are not bilobed; inferior canine larger than incisors; four inferior premolars, the first and second separated by a diastema.....*Bathyopsis* Cope.

Four subequal (? bilobed) symphyseal teeth on each side; inferior premolars four (teste Marsh).....*Ditetrodon* Cope.

Two or three subequal symphyseal teeth on each side; three inferior premolars *Uintatherium* Leidy.

No inferior canines or incisors; three inferior premolars.....*Tetheopsis* Cope.

Most of the known species belong to Loxolophodon, each of the remaining four genera having but one species each. Loxolophodon includes as synonymes the names Dinoceras and Tinoceras Marsh, which were proposed as nomina nuda after Loxolophodon, and were not characterized until several years later. It is uncertain whether Eobasileus, which was proposed and defined at about the same time as Loxolophodon is distinct from it or not. Octotomus is also a synonyme. Ditetrodon is established on *Uintatherium segne* Marsh, and Tetheopsis on *Tinoceras stenops* Marsh.—*E. D. Cope.*

THE UNITED STATES GEOLOGICAL SURVEY.—In an article upon the organization and plan of the United States Geological Survey, published in the *American Journal of Science*, Mr. J. W. Powell states that, where the topography and geology are simple, as in the prairies and great plains, the sheets of the United States survey map are made on a scale of 1–250,000, or about four miles to the inch; while farther west, where both structure and topography are more complex, special districts are made to twice this scale, and important mining districts are drawn much larger. In the less densely populated portions of the eastern part of the United States, a scale of 1–125,000 is used, but the more densely populated portions are drawn to twice this scale, or about one mile to the inch. The whole of the United States and Alaska will, upon this plan, require not less than 2600 sheets; besides several hundred special maps. With the present organization, the map of the United States will be completed in about twenty-four years. About one-fifth of the United States (Alaska excluded) has hitherto been mapped.

INSECTS OF THE CARBONIFEROUS PERIOD.—The recent discoveries of Mr. Charles Brougniart in the insect fauna of Commen-

try, France, have thrown a flood of light over the obscurities of the Carboniferous epoch. Wings of a type which all writers had agreed were at any rate neuropterous, and referred to a special genus, Dictyoneura, are found by him attached to bodies which are clearly orthopterous, and of a specialized group, which one would scarcely have looked for in ancient times. Additional species now occur from time to time, and the number of forms referred to Dictyoneura is constantly growing. Others allied to them have been referred, and are still being referred, to other genera, and to still other divisions of Neuroptera.

Under these circumstances, and because a number of new American types need to be brought into their proper place, I have thought best to offer a brief synopsis of those Carboniferous forms heretofore discovered (with a few additional ones from this continent), which may be referred to the ancient Phasmida.

Among them will be found nearly all the species heretofore referred to the Termitina from the European coal measures, for a careful study shows that the white ants were not at all represented in Palæozoic times, so far as the forms yet discovered show. Most of those which have been considered Termitina belong rather here (they have already in several instances been referred here), while others belong to other groups of Neuroptera than Termitina.—*S. H. Scudder, in Proceeds. Amer. Acad. Arts and Sciences.*

Geological News.—*General.*—The Boletin Acad. Nac. de Ciencias de Cordoba contains two articles by L. Brackebusch upon the geology of the province of Jujuy. Except for the information gathered in 1876 by Lorentz and Hyeronimus, and some notes on the primordial fauna by E. Kayser, this northern part of the Argentine Republic has hitherto been geologically unknown. The south-eastern part of the province, near the Vermejo, is comparatively low, though even here the Sierra of St. Barbara rises west of the Rio S. Franciso to 3000 meters. The larger central and western portion is entirely a mountain land, range after range rising to heights of from 4500 to 5500 meters, separated by valleys, some of which are basin-like depressions, 30–60$^{km.}$ broad. This western part is sterile, while the east is highly fertile. The mountains of Jujuy have a closer relation to the Bolivian plateau than to the chains of the center and west of the Argentine provinces. The most western chains (Sierras de la Puna) consist principally of clay slates, alternating with grauwacke, and, save in one locality, are without fossils. The easterly Sierra de Chuni consists of slates, grauwacke and sandstones, the last rich in Silurian fossils, graptolites, trilobites, cephalopods and brachiopods. Newer formations occur in the basins between the mountains, gypsum-bearing sandstone, dolomite, limestone, oölite and bituminous shales, etc. Fish and insect remains have been found in the Sierra St. Barbara. Strata corresponding to those which

d'Orbigny referred to the triassic in Bolivia are by Brackebusch placed in the Wealden or Neocomian. In these Mesozoic strata occur many petroleum springs, and throughout Jujuy and Salta, in Bolivia, and probably below the diluvium of the Gran Chaco, the character of the formation is such that Brackebusch styles it the "petroliferous formation." A small basin near Jujuy has Post-tertiary strata, with beds of lignite and mastodon remains. Eruptive rocks occur in many localities, and gold ore is found in the beds of the streams which flow from the Sierra Cabalonga. ——Part 1 of the "Grand Atlas of the Second Geological Survey of Pennsylvania," with fifty sheets imperial folio, has been published at Harrisburg.——The two "Prix Vaillant" of the Academie des Sciences de Paris have been given, the first to M. Gustave Cotteau, for his researches among fossil echinoderms; the second to M. Emile Riviere for his work in prehistoric anthropology. M. Cotteau has published more than 1000 plates of echinoderms; and for thirty years has been known as a palæontologist. The results of the researches of M. Riviere have been published in a work entitled "L'antiquité de l'homme dans les Alpes Maritimes."——M. Dieulafait is now engaged in studying the deposits of iron, manganese and zinc which exist around the "Plateau central," in the Cevennes particularly. He arrives at the conclusion that these deposits are derived from the primordial rocks from which they were extracted by the action of sea water.——A. W. Waters has described more fossil cheilostomatous Polyzoa from South Australia. Of the 220 species now described in the series of papers, about half are still living. The species noticed in this paper are seventy-three in number. Attention was called to the fact that, though the shape and nature of the zoœcial avicularia are characters of the greatest value, yet their presence or absence cannot be made a specific distinction, as there are a large number of cases where specimens are found with none or only a few such avicularia, whereas on other specimens of the same species they may occur abundantly.

MINERALOGY AND PETROGRAPHY.[1]

Physical Mineralogy.—*Cohesion.*—It has long been known that, aside from directions of minimum cohesion (true cleavage) in crystals there are certain planes in which a slipping of the molecules takes place with especial ease. These are called by the Germans "*Gleitflächen*," and to our knowledge of them a considerable series of papers by Mügge has largely contributed. This writer concludes that the "*Gleitflächen*" coincide with the cohesion maxima along which the molecules can be parted only with the greatest difficulty, while they may be made to slip or slide over each other as easily in this as in any other direction. The

[1] Edited by Dr. Geo. H. Williams, of the Johns Hopkins University, Baltimore, Md.

position of these planes was determined for gypsum, stibnite, bismuthinite, orpiment and cyanite,[1] and found to agree as regards their direction with what had earlier been observed in the case of mica, rocksalt, calcite and galena. Later, the application of Reusch's method of forming the so-called fracture figures ("*Schlagfiguren*") showed that the same was also true of erythrite, vivianite, hydrargillite, brucite, potassium ferrocyanide, uranium mica and even apophyllite and topaz. In the case of the two latter minerals, it was necessary to use a diamond-pointed instrument to make the impression.[2] Most interesting, however, are these "gleitflächen" in calcite, where they stand in the closest relation to the twinning planes. As "*structure planes*" Mügge designates all those along which slipping or a parting of the molecules can be readily effected. Of these in calcite R is the true cleavage plane ("Spaltungsfläche"); $-\frac{1}{2}R$ the slipping plane ("Gleitfläche"), while parallel to $\infty P2$ and $0R$ parting readily takes place under pressure in the proper direction ("Reissflächen"). If an artificial sliding of a portion of a calcite rhombohedron into twinning position parallel to $-\frac{1}{2}R$ be effected, the position of the R-faces remains unchanged; the $-\frac{1}{2}R$-faces, except the one in which the sliding took place, assume the position of $\infty P2$ planes, while these in turn come to occupy the place of $-\frac{1}{2}R$. A $0R$-face takes the position of $-2R$, parallel to which a parting has also been observed by Haidinger and Tschermak. Thus all the structure planes retain the same positions, although they exchange them among themselves. It is significant that all these planes, except $\infty P2$, which is a plane of symmetry, have been observed as twinning planes for calcite.[3] The great ease with which by slight pressure the molecules of calcite may be pushed into twinning position parallel $-\frac{1}{2}R$ suggests a similar origin for the lamellar twinning of many silicates, especially as this is often observed to be most developed where the pressure has been greatest. Van Werveke has called attention to this in the case of feldspar and diallage;[4] Bauer, in the case of cyanite.[5] Analogous examples seem to be Malacolite and salite ($\parallel 0P$), epidote and mica. [The present writer has recently observed that the apparently perfect cleavage of so much of the American sphene is conditioned by fine twinning lamellæ parallel to the face $-4P$ (Dana), which appear to belong to this same category, and may possibly have been produced by pressure. Hornblende rarely exhibits the same structure parallel to $0P$.][6] Mügge also describes twinning lamellæ in imbedded masses and crystals of hematite and corundum. They

[1] Neues Jahrbuch für Min., etc., 1883, II, p. 13.

[2] Ib., 1884, I, p. 50.

[3] Neues Jahrbuch für Min., etc., 1883, I, p. 32.

[4] Ib., 1883, II, p. 97.

[5] Zeitschrift der deutschen geol. Gesell., 1878, XXX, p. 320.

[6] Amer. Jour. of Science, June, 1885.

lie parallel to the face R, which plays here the same *rôle* as "Gleitungsfläche" as $-\frac{1}{2}R$ does in calcite. A similar structure is frequent in the Graves Mt. rutile parallel ∞P.[1] In these cases also, as with the silicates, the nature of the material prevented the artificial production of the lamellæ. In some minerals where no alteration of molecular arrangement could be brought about by pressure, this result was accomplished by heat. By a sufficient increase of temperature twinning lamellæ were seen to be developed in anhydrite,[2] cryolite[3] and leadhillite,[4] while thenardite was rendered optically uniaxial,[5] as Mallard had showed was the case with the corresponding potassium salt. (For the very interesting results of a similar nature obtained by Förstner on the feldspars of Pantellaria, see below.) W. Klein[6] contributes an interesting paper on the influence of heat on the optical properties of crystals, especially when this is applied unevenly to different portions of the section. Negative, uniaxial minerals, like apatite and calcite, show an opening of the interference figure into two hyperbolas, the line joining them being perpendicular to the direction in which the heat is applied. For positive crystals the same is observed, except that this direction is parallel to the line joining the hyperbolas. Biaxial crystals also exhibit similar phenomena, so that uneven heating may be regarded as a test of the character of double refraction similar to the use of the quarter undulation mica plate. The mineral, *heulandite*, is also made the subject of an extended investigation, the results of which cannot be here given. The *beaumontite* from Baltimore, commonly regarded as a variety of heulandite, shows such an entirely different optical behavior that the writer is inclined to agree with Rose in regarding it as a separate species.

J. Beckenkamp[7] describes a new and delicate apparatus for the measurement of the constants of elasticity in crystals. The results of numerous determinations are given whereby the conclusion is reached that the elasticity, like all the other physical properties of crystals, is in exact accord with the geometrical properties. The elasticity of alum was found to be less than that of any other known substance, which accounts for its anomalous double refraction, inasmuch as very slight pressure can produce a molecular disturbance. The elasticity of any crystal was found steadily to decrease with repeated compression.

R. Brauns[8] considers that the much discussed optical anomalies

[1] Neues Jahrbuch für Min., etc., 1884, I, 216.
[2] Ib., 1883, II, p. 258.
[3] Jahresbuch der Wissensch. Anstalten zu Hamburg, 1883, p. 67.
[4] Neues Jahrbuch für Min., etc., 1884, I, 63.
[5] Ib., 1884, II, p. 1.
[6] Zeitschrift für Krystallographie, IX, 1884, pp. 38–72.
[7] Ib., X, 1885, 41–57.
[8] Neues Jahrbuch für Min., etc., 1885, I, 96–118

of regular crystals are in many cases due to chemical impurity, especially the crystallizing together of isomorphous compounds. Alum, rocksalt, garnet and other substances are described. The same reason is assigned for uniaxial minerals exhibiting a biaxial character.

W. Voigt,[1] of Göttingen, has developed mathematically a theory to account for the peculiar interference figures exhibited by certain pleochroic (idiocyclophanic) crystals recently described by Bertin (*Zeitschr. f. Kryst.*, III, p. 449).

THE FELDSPARS.—Professor Des Cloizeaux, of Paris, has just published at Tours a valuable memoir of ninety-two pages, entitled "Oligoclases et Andésine," being an enlargement of his former paper, "Nouvelles recherches sur les propriétés optiques des oligoclases," which appeared in 1880,[2] and a direct continuation of his still more recent studies on albite[3] (vid. NATURALIST, 1884, p. 184). The latter paper describes thirty-four specimens from different localities, of which ten are American (Mineral Hill, Pa., Moriah, N. Y., Middletown, Ct., and Canada). In the present communication the number of oligoclase specimens examined has been increased from forty-four to sixty-six. These are divided into the following four classes:

1st. *Anomalous oligoclase or oligoclase-albite.*—The surface perpendicular to the plane of the optical axes truncates the *acute* edge P:M., making with P an angle of 93°. The extinction on M makes an angle of 6°–12° with the edge P:M, in a positive sense according to Schuster. Oxygen ratios vary between 1 : 3 : 10 and 1 : 3 : 10.7., corresponding to the mixtures. $Ab_8\ An_1$—$Ab_6\ An_1$.

2d. *Anomalous oligoclase.*—Plane of the optical axes is parallel to the basal pinacoid or perpendicular to the brachypinacoid. Extinction on M is positive, 6°–9° inclined to the edge P:M. Oxygen ratios vary from 1 : 3 : 10.4 to 1 : 3 : 9, corresponding to the mixtures $Ab_4\ An_1$—$Ab_2\ An_1$.

3d. *Normal oligoclase.*—Surface perpendicular to the opt. axial plane truncates the *obtuse* edge P:M, making with P an angle of 98°–104°. The extinction on M is positive, inclined 1°–6° (generally 2°–4°) to the edge P:M. Oxygen ratio is 1 : 3 : 9 :=$Ab_2\ An_1$.

4th. *Andesine.*—Surface perpendicular to the plane of the optical axes truncates the *obtuse* edge P:M, making an angle of 110°–120° with P. The extinction on M is negative, varying from 1°–10°. Sp. Gr. = 2.67. Oxygen ratio 1 : 3 : 8, corresponding to $Ab_1\ An_1$.

The first-class includes nine specimens examined, of which one is American (Colton, N. Y.). The second-class includes eleven

[1] Neues Jahrbuch für Min., etc., 1885, I, 119–141.

[2] Bull. Soc. Min. de France, 1880, III, 157.

[3] Ib., 1883, VI, 89–121.

specimens of which one is from Colton, N. Y., and one from Mineral Hill, Del. Co., Pa. The third-class includes sixteen specimens, mostly from Scandinavia, and the fourth-class nineteen specimens, of which one was from Château Richer in Canada. The remaining eleven specimens examined by the author did not yield altogether satisfactory results.

Very interesting facts regarding the relations between the monoclinic and triclinic feldspars have been obtained by Dr. Förstner of Strassburg, through his studies of material from the island of Pantellaria.[1] He finds that both the potash (orthoclase) molecule and the soda (albite) molecule undoubtedly possess a stable and unstable modification, the former being for orthoclase in the monoclinic, the latter in the triclinic system (microcline), while exactly the reverse is the case for albite. It has long been known that some varieties of orthoclase, especially sanidine, contain a very considerable amount of soda and the existence of the triclinic form of the potash molecule has been universally acknowledged since the classic investigations of Des Cloizeaux.[2] Förstner finds on Pantellaria that a monoclinic feldspar containing 2.1 albite molecules to every molecule or orthoclase occurs as a constituent of a certain rhyolite (Cala Porticello and Bagno dell' acqua). This he calls "Natronorthoclase." It is very similar both in composition and structure to that described by Brögger[3] and Mügge[4] from Norway, and by Klein,[5] from Hohen Hagen, near Göttingen. Even more common on Pantellaria, as a constituent of the augite andesite and pantellarite (a dacite characterized by a peculiar triclinic amphibole called "Cossyrite[6]") is a series of triclinic feldspars intermediate between albite and microcline. Very remarkable is the ease with which these intermediate members—natron-orthoclase and albite-microcline—can be transferred by artificial means from one modification to the other. Some albite-microcline (Cuddia Mida) shows, even by a temperature of 86°–115° C., a disappearance of its twinning lamellæ and by other optical changes is plainly seen to pass from the triclinic to the monoclinic system. The oligoclase-microcline from Mt. Gibele, on the other hand, remained unchanged even at 500° C. Most feldspars of this series changed back to their original triclinic form when the temperature was again reduced, except when it had been raised as high as 500°, in which case the change to the monoclinic form was as a rule permanent. The natron-orthoclase showed no change while being heated, but on being cooled from

[1] Zeitschrift für Krystallographie, VIII, 1883, pp. 125–202; IX, 1884, pp. 333–352.

[2] Comptes rendus, 1876, p. 885.

[3] Die silurischen Etagen 2 und 3 im Kristianiagebiet, etc.; Kristiania, 1882, pp. 258–262; 293–307.

[4] Neues Jahrbuch für Min., etc., 1881, II, 106.

[5] Göttinger Nachrichten, 1878.

[6] Zeitschrift für Krystallographie, V, 348.

a temperature of 264° C., it passed from the monoclinic to the triclinic modification, having a distinct system of twinning lamellæ and an inclined extinction of 2° against the cleavage lines on oP. The same feldspar was also found to undergo a like alteration when subjected to pressure, thus experimentally proving the suggestion of Van Werveke[1] that many plagioclase crystals owed their twinning striation to the pressure to which they had been subjected in rocks.

HYPERSTHENE-BASALT.—A correction should be made to the statement in the Petrographical Notes (NATURALIST, April, 1885, p. 395), that Mr. J. S. Diller was the discoverer of the new rock type hypersthene-basalt. This rock was described by Messrs. Hague and Iddings in 1883,[2] in their Note on volcanoes of Northern California, Oregon and Washington Territory, and again in 1884[3], in their Notes on the volcanic rocks of the Great basin. It is, however, here spoken of as olivine-bearing hypersthene andesite, or as hypersthene-bearing basalt. These authors regard the hypersthene and olivine as playing complementary *rôles* in the lavas, *i. e.*, one being a singulosilicate and the other the corresponding bisilicate; in case a basalt grows slightly more acid the hypersthene replaces the olivine, which therefore diminishes in quantity as the other increases. In this way hypersthene-basalt may be regarded as a connecting link between basalt and hypersthene-andesite.

BOTANY.[4]

FERTILIZATION OF THE WILD ONION (ALLIUM CERNUUM).—The wild onion grows in masses along the banks of shady streams in August. The flowers are arranged in dense umbels, which are nodding as their specific name implies. They are of a beautiful rose color, presenting an attractive appearance, when seen from a distance. There are six stamens, which arrive at maturity one after the other, the outer row developing first (Fig. 1). In this

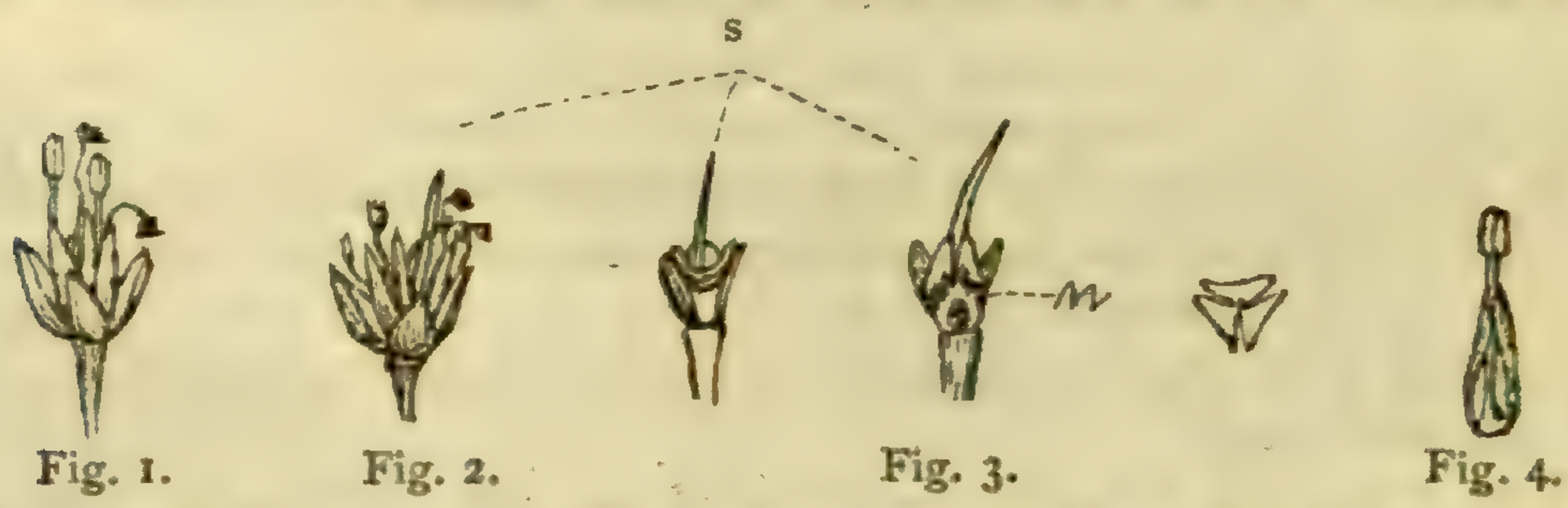


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. Antheriferous period. Fig. 2. Female state. Fig. 3. The three processes with nectaries (*n*) at their junction. Fig. 4. A stamen attached to an inner member of the perianth and enfolded by it.

successive development they resemble the usual course in the an-

[1] Neues Jahrbuch für Min., etc., 1883, II, p. 87.
[2] American Journal of Science, Sept., 1883, p. 233.
[3] Ib., June, 1884, p, 457 and p. 460.
[4] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

droecium of Umbelliferæ. The style remains small, maturing after the anthers have dehisced, presenting thus a case of simple proterandry. The last stamen has shed its pollen before the stigma matures (Fig. 2). Both stamens and pistils protrude considerably from the perianth, some of the anthers being empty while others in the same flower are immature or dehiscing. The stamens composing the outer row are partly enfolded by the inner set of the perianth to which they are attached at their base (Fig. 4). This tube serves as a guide to the nectary which lies just in front of the base of the inner set of the perianth. The nectary itself is a curious device, consisting of three organs placed so as to cover the ovary, being adnate to it, and bilobed above in such a manner that the contiguous lobes approach each other and serve as a cover to the three nectary glands just beneath their place of meeting. The nectary gland is thus enclosed by these processes of the ovary and the inner row of the perianth (which enfolds these processes or lobes, one sepal to each pair of lobes). The lobes afterwards appear as six teeth cresting the maturing ovary. Cross-fertilization is necessary in these plants and the office is undertaken by various sized bees. Self-fertilization apparently is impossible.—*Aug. F. Foerste, Granville, Ohio.*

The Continuity of Protoplasm in many-celled Plants.—A paper recently published in *Nature*, by Dr. Schaarschmidt, contains a summary of the results of investigations as to the continuity of protoplasm in the many-celled plants. From this it appears that the first direct observations were made by Theodore Hartig, in 1854, who described the continuity of the protoplasm in sieve tubes. This case of continuity confirmed by many observers remained the only one, until the year 1878, when Bornet and Wright published papers in which the communication between adjacent cells of the Florideæ was described. In 1879 or 1880, the communication between the endosperm cells of phanerogams was observed. Since that time numerous observations have been made, all tending to show that the phenomenon is far more general than at first suspected.

It has also been shown that protoplasm occurs in intercellular spaces; and now Dr. Schaarschmidt announces the discovery of inter-lamellar protoplasm, that is of a thin layer which occupies the position of what has been long known as the "middle lamella" of the cell wall

The "general results" are given by the author, as follows: (1) "The protoplasts of all the tissues in united cells are in direct connection by means of finely attenuated protoplasmic threads.

(2) "The connective threads traverse the pit-closing membrane (which is of a sieve-plate structure), while in unpitted cells they traverse directly the cell wall. By these threads is the communication between the connective process which occupy the pit-cavity from both sides directly established.

(3) "The intercellular plasm occurs not only in the intercellular spaces of the parenchymatic tissues, but also in those of true prosenchymatic tissues.

(4) "This intercullar plasm contains, in many cases, chlorophyll granules (in Viscum).

(5) "The intercellular plasm is in direct connection with the adjacent protoplasts.

(6) "Corresponding to the middle lamella around the cells, we find a plasmatic frame; the sides of this frame end in the 'intercellular plasma. This plasmatic frame forms a veritable mantle around the protoplasts, and it is increased at each edge by an intercellular plasm portion, which latter has a pillar form.

(7) "The connective threads of the protoplasts traverse this 'middle lamellary' plasma; both are also connected.

(8) The probable origin of this intercellular plasma is this: During the cell-division, when the division was almost ended, little cytoplasmic portions become included in the young cell wall, and it is also very probable that the connective threads, in many instances, are the remainder of the 'nuclear connective threads,' and that the middle-lamellary protoplasm is the remainder of the 'cell-plate.' All these plasma portions are by the thickened cell-wall much compressed together, and therefore only visible, or distinctly visible by the swelling of the cell-wall.

(9) "The intercellular plasm can cover itself with a cell-membrane, and in this way we find at the place of the intercellular spaces veritable new cells. About these new cells, appear later new secondary or tertiary intercellular spaces.

(10) "The protoplasm of the crystal-bearing cells (crystal glands), and that of the resin-canal cells is also in communication with the adjacent cells.

"The protoplasts of the plants (composed of tissues) form a higher unity, one synplast."

WILLKOMM'S ARRANGEMENT OF THE VEGETABLE KINGDOM.—In a review of a recently published "Bilder Atlas," by M. Willkomm, in the *Botanisches Centralblatt*, the following is given as his proposed arrangement of the vegetable kingdom:

FIRST KINGDOM. SPOROPHYTA.

Division I. Thallophyta.

Class I. Mycetoideæ, containing the orders 1. *Myxomycetes* and 2. *Fungi.*

Class II. Phycoideæ, containing the orders 3. *Lichenes*, and 4. *Algæ.*

Division II. Cormophyta.

Class III. Protonemaceæ, orders 5. *Hepaticæ* and 6. *Musci.*

Class IV. Prothallionatæ, orders 7. *Equisetinæ;* 8. *Lycopodinæ;* and 9. *Filicinæ.*

SECOND KINGDOM. SPERMATOPHYTA.

Division III. Gymnospermæ.

Class V. Pseudocarpæ, orders 10. *Cycadeæ;* 11. *Taxineæ;* 12. *Coniferæ;* and 13. *Ambiguæ.*

Division IV. Angiospermæ.

Class VI. Acotyledoneæ, order 14. *Rhizantheæ.*

Class VII. Monocotyledoneæ, orders 15. *Fluviales;* 16. *Spadicifloræ;* 17. *Principes;* 18. *Glumaceæ;* 19. *Enantioblastæ;* 20. *Helobiæ;* 21. *Gynandræ;* 22. *Scitamineæ;* 23. *Ensatæ;* 24. *Artorrhizæ;* 25. *Coronariæ.*

Class VIII. Dicotyledoneæ, orders 26 to 71, in approximately the sequence followed in Bentham and Hooker's Genera Plantarum. The "orders" here are, however, groups of higher rank than the "orders" of Bentham and Hooker, being in fact in many cases nearly synomymous with the "cohorts" of the authors last named.

The place assigned the Slime-molds (Myxomycetes) indicates the acceptance of what we have for many years considered to be the true interpretation of their structure and relationship. In like manner the treatment of the Gymnosperms indicates a more philosophical spirit and a practical recognition of the doctrine of evolution.

THE STUDY OF THE LIVERWORTS IN NORTH AMERICA.—As one of the results of the one-sidedness of the usual teaching of botany in this country, whereby it is almost entirely restricted to the flowering plants and "vascular cryptogams," we find a most unequal distribution of workers throughout the various botanical fields. We have any quantity of "phanerogamists," but though the cryptogamic fields bear a plenteous harvest, the laborers are few, and year by year as the scattered workers are cut off by death, there are few among the younger ones to take their places. There must be something faulty in the instruction given by our botanical teachers in the many colleges and universities in this country. The results would indicate that in too many cases the kingdom of plants is supposed to come to an end just a little way beyond the boundary of the phanerogams.

These thoughts are suggested by a little book recently brought out by Dr. L. M. Underwood, under the modest title of a Descriptive Catalogue of the North American Hepaticæ North of Mexico. In a prefatory note the author says, "The study of hepaticæ is attended with much difficulty for several reasons, among which may be named the following:

1. These plants are very largely neglected by collectors.
2. The literature on the subject is rare and inaccessible.
3. Most of our public and college libraries contain little or no literature upon this subject.
4. Many of the species described as new by American writers are not represented in any American collection.

It is to be hoped that the purpose of the book as stated by the author "to relieve in part these difficulties, and to stimulate a more complete collection of Hepaticæ" may be realized.

Turning to the body of the book we find a few pages devoted to the general characters of the liverworts, time of collecting, geographical distribution, essential characters, bibliography, etc., the remainder of the book being filled with the descriptive catalogue.

As to the time for collecting, the author says: "The hepatics should be collected for preservation and study when in fruit, if this be possible, and this condition occurs at different seasons in the various species; some bear fruit in late autumn, some in early spring, some in midsummer; in short, there is scarcely any season of the year, even winter, that will not find some form in fruit, yet the period from October to May may include the larger number of species for the cool temperate regions of America. Many species have never been found in fruit, and possibly never produce fruit, so it will be advisable to collect all species whether in fruit or not, for otherwise these less known forms may be neglected."

Comparing the systematic portion of this work with that of Sullivant, which was published in Gray's Manual, twenty-five years ago or thereabouts, we find a very considerable increase in the number of genera and species.

Orders of Hepaticæ.	*Genera.*		*Species.*	
	Sullivant.	Underwood.	Sullivant.	Underwood.
Ricciaceæ.....	2	3	8	24
Marchantiaceæ.....	8	13	12	22
Anthocerotaceæ.....	2	2	6	14
Jungermanniaceæ.....	26	32	82	169

An effort has been made to help the beginning by a judicious introduction of keys and synoptic characters, which from a personal trial we can assure the reader is fairly successful. The book ought to stimulate our younger botanists to take up the study of these plants, and we trust that the request of the author that collectors communicate specimens of the forms found in their localities may be abundantly rewarded.—*Charles E. Bessey.*

Botany at Salem.—The following extract from Professor Robinson's annual report of the work of the Peabody Academy of Science (the old home of the Naturalist) shows a commendable activity in its botanical department during the year 1884:

"In the department of botany a great improvement has been made. As various collections were from time to time arranged they have been placed in boxes in the dark spare-room on the lower floor of the museum. This year a suitable herbarium case of white wood, containing ninety-six compartments, has been placed in the lecture-room, in which all the Essex county collections and the general reference collection from North America have been arranged. Other collections have also been placed in the lecture-room, so that now the herbarium is in a dry and pleasant room where it can be easily referred to by those in charge of it and by students who desire to consult it.

"The academy now owns a very good collection of botanical reference books, and two microscopes, which, under proper restrictions, are placed at the disposal of any persons desiring to compare species at the museum. The herbarium is by far the best in the county; it is centrally and conveniently situated, and has

been frequently consulted through the year by students in this department of study. The special work on this collection has been the arrangement of the Algæ, of which there were a large number of specimens."

Botanical News.—For some time occasional papers have appeared in the *Amer. Mo. Micr. Jour.*, attempting to throw doubts upon the prevailing views as to the mode of fertilization in flowering plants. Microscopical preparations by Mr. J. Kruttschnitt, have been sent out for examination, with the intention of proving the new view. The editor of the *Botanical Gazette* in the January number devotes about a page to an indignant denunciation of the whole matter. In the January Jour. N. Y. Micr. Society, Dr. N. L. Britton devotes ten pages to criticisms of Mr. Kruttschnitt's papers and preparations. He closes by saying, "The fact of failure on the part of one, or indeed, of several persons, to discover a pollen tube in contact with the embryo-sac of an ovule, can, it seems to me, have no weight when viewed in connection with the fact that so many able investigators have often and undeniably seen such contact." The friends of this wild theory need no longer complain of its being ignored by botanists!——A. H. Curtiss, of Jacksonville, Florida, has prepared two series of wood specimens, including seventy-five species in each. Each specimen shows heartwood, sapwood and bark, and is accompanied by a printed label. The low price at which they are sold ($15 per single single series, or $25 for the two) ought to place them in many a botanical cabinet.——An important pamphlet On the establishment of a Botanical Garden and Arboretum in Montreal, has been issued recently by the Montreal Horticultural Society. It gives some valuable statistics as to the botanic gardens of the world, and sets forth their scientific and practical value. It is mainly from the pen of Professor Penhallow.——One of the most valuable catalogues issued by the exhibitors at the New Orleans Exposition is that enumerating the articles forwarded from the Island of Jamaica, the work of Mr. D. Morris. It is particularly interesting as containing classified lists of plants and plant products.——The collection of Florida woods in the exposition is one of the finest on exhibition. It was prepared, we are assured, by A. H. Curtiss, of Jacksonville.——The collection of California plants shown by J. G. Lemmon in the exposition, contains nearly a full set of the ferns of the Pacific coast.——One of the absurdities to be seen in the exposition is a large well painted sign over a section of a big tree *(Sequoia gigantea)* which gravely informs the seeker after wonderful things that these trees attain the age of 3700 years!——Strasburger's Kleine Botanische Practicum has just been received. It is to our mind a much more useful and usable book than the large one. It should be translated and republished at once in this country for the benefit of American students.——The thirty-fifth and thirty-sixth reports

PLATE XVIII.

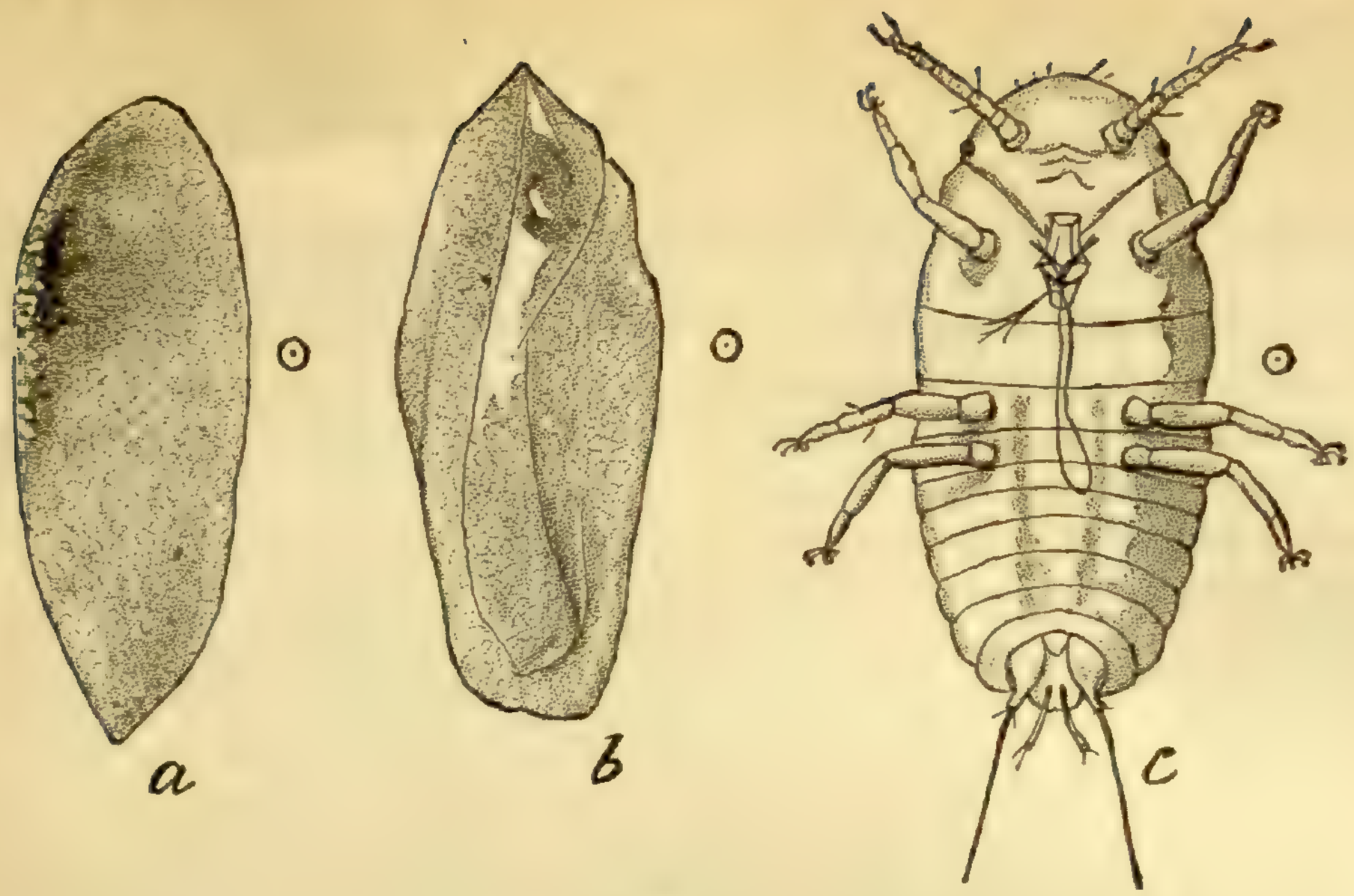


Fig. 1.

Fig. 2.

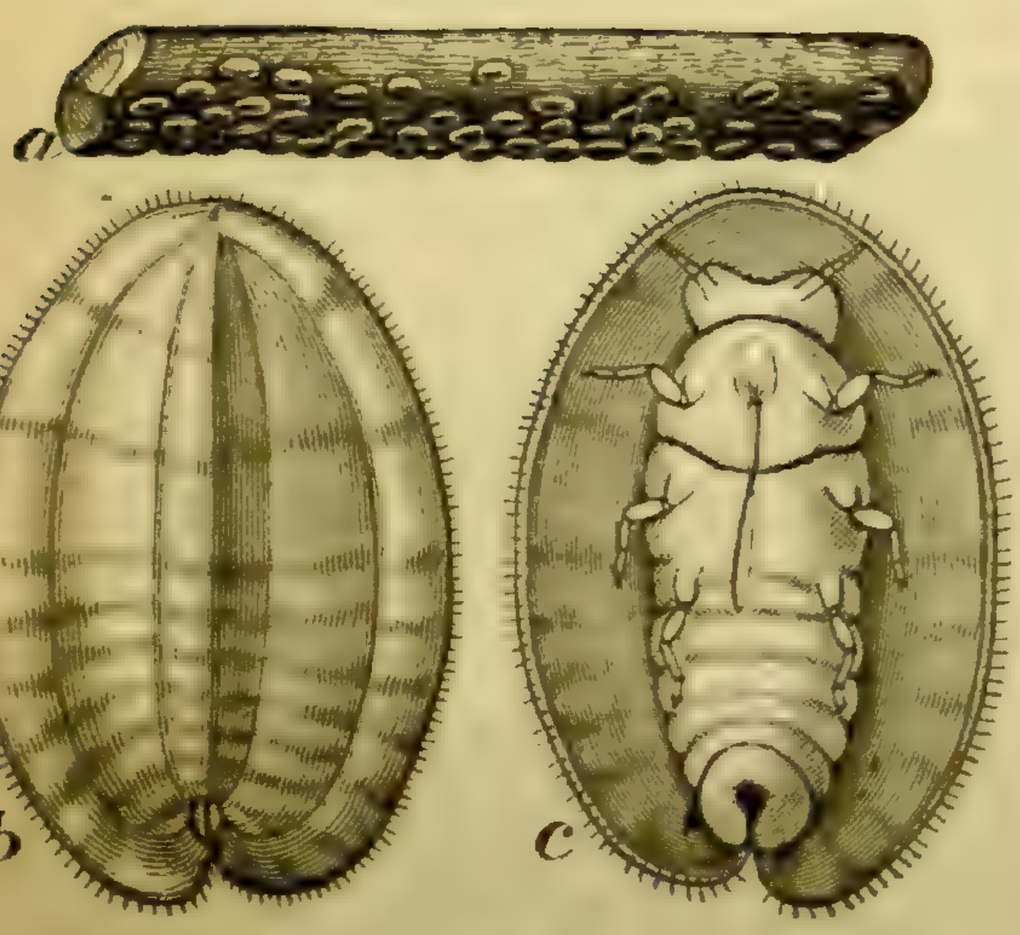


Fig. 3.

THE COTTONY MAPLE SCALE. Fig. 4.

of the State Botanist of New York have come to hand. In the first, all the New York species of the sub-genus Lepiota of Agaricus, are described and systematically arranged, and in the second those of the subgenus Psalliota. Valuable notes and remarks upon various plants form a feature as heretofore of both reports, and quite a good number of new fungi are described. We only regret that it requires two years for these reports to go through the press.

ENTOMOLOGY.

RILEY'S ENTOMOLOGICAL REPORT FOR 1884.—The last report of the entomologist of the Department of Agriculture fills about 150 closely printed pages, with ten excellent plates and a full index. In practical as well as scientific value and in the variety of subjects treated, it is not inferior to its predecessors. The cabbage cut-worms are described at length and well illustrated, as well as a number of other insects destructive to this plant. Efforts have been made to introduce and colonize the European ichneumon parasite (*Apanteles glomeratus*) of the imported cabbage worm, and thus far the experiment has been successful.

The report contains also interesting life-histories of the American Cimbex, which has in Washington injured the willow, and lengthy notices are given of the Southern buffalo gnat, the angoumois grain moth, the cottony maple scale, the cranberry fruit worm, the larger wheat straw Isosoma, etc. Much attention is paid to the use of remedies.

The reports of the special agents comprise those of Mr. Hubbard on the rust of the orange, Professor Packard's on the causes of destruction of the evergreen trees of Northern New England and New York; Mr. Webster's on the insects affecting fall wheat; Mr. Smith's on those affecting the hop and cranberry; and Mr. Bruner's on the Rocky mountain locust, etc., in Nebraska. As a sample of the excellent illustrations is Pl. XVIII, which represents the cottony maple scale, with its eggs and larva (Fig. 1), the leaf with male scales (Fig. 2), the female scales (Fig. 3), and in Fig. 4 the adult females with the wooly egg-mass as seen late in the spring.

LATZEL'S MYRIOPODA OF AUSTRO-HUNGARIA.—This admirable work bears all the marks of faithful and exhaustive labor, whether we consider the text or plates. The descriptions of the orders, suborders, families, genera as well as species are given in detail, especially those of the orders and genera, and the work will thus be of special value to American students.

This part contains monographs of the Symphyla, Pauropoda. and Diplopoda. Personally the reviewer does not regard the Symphyla, represented by Scolopendrella, as genuine myriopods, but none the less would he cordially welcome the work which

Latzel has bestowed upon them, especially his figures of the mouth-parts.

For the Chilognatha Latzel adopts the term Diplopoda of Blainville and Gervais; the latter term is a better one[1] if it has priority, as it is shorter and more expressive, but the author does not give his reasons for using it in preference to the commoner name. However, he regards the Chilognatha as the second suborder of Diplopoda, proposing two new suborders, first the Pselaphognatha (for the Polyxenidæ), and third and lastly the Colobognatha for the Polyzonidæ, all the other diplopods being placed under the Chilognatha.

The Lysiopetalidæ, as limited by American authors, is dismembered, all except Lysiopetalum being referred to the family Chordeumidæ, whereas he should regard the two groups as sub-families of Newport's group Lysiopetalinæ, established in 1844. The American genera Scoterpes, and Zygonopus are considered as identical, a view we at first entertained, but afterwards abandoned, so great is the difference in the sixth pair of legs and the male genital armature. Trichopetalum is regarded as identical with Craspedosoma and perhaps partly with Chordeuma.

Trouessart and Megnin's Sarcoptid Mites.—The first part of Trouessart's "Les sarcoptides plumicoles ou Analgésinés," embraces an account of Pterolichus and its allies, worked out with the aid of M. P. Megnin. These mites live on the plumage of birds, feeding upon the oily substance excreted by the skin, and not annoying the birds themselves; they are not then true parasites, but simply commensals. Several new genera and many new species are described, and the present part is illustrated by about twenty-five wood-cuts. About 150 species will be described. They have been taken from birds brought from different parts of the world, and it has been found that the same species of the subfamily lives on all species of birds belonging to one family. They are exposed to much variation, particularly *Fregana anatina.* The great variability of this species is readily explained by the parasite habits and by special condition of the medium, of food, habitat and climate. The work promises to be of much value to American students, for the subject here is almost unworked.

Entomological News.—The twelfth volume of the Transaction of the American Entomological Society opens with the second part of the late Dr. LeConte's Short studies of North American Coleoptera; and is followed by Dr. Horn's Study of some genera of Elateridæ; Mr. Williston's Notes on the North American Asilidæ (Part II); Mr. John B. Smith's Notes on the systematic position of some North American Lepidoptera, re-

[1] Die Myriopoden der Osterreichisch-Ungarischen Monarchie. Von Dr. Robert Latzel, Hälfte II. Die Symphylen, Paurodopen und Diplopoden. Wien, 1884. Alfred Hölder, 8vo., pp. 414, 16 Tafeln.

ferring especially to the Zygænidæ. It seems to us that Mr. Smith in this essay fails to take a comprehensive view of the group; his families are sub-groups, and to base families wholly on the venation is carrying matters to an extreme; the venation in this family seems to us to be mainly useful in defining genera. Mr. Smith is led to throw Endryas out of the family, whereas by its larval, pupal and head and trunk characters it is a true Zygænida, the characters Smith uses are, we think, superficial. The two closing articles of the first number of the volume are by Dr. Horn, on the North American species of Cryptobium and Studies among the Meloidæ.——Interesting notes on oviposition in Agrion and insect migration appear in the *Entomologists' Monthly Magazine* for February.——Mr. T. L. Casey's Contributions to the descriptive and systematic Coleopterology of North America contains carefully prepared and lengthy descriptions of new genera and species of American beetles which will be of permanent value. We trust that the time for sub-lined descriptions of Coleoptera has gone by.——At a meeting of the Entomological Society of London, held Feb. 4, Mr. W. L. Distant exhibited a series of wings of Indian butterflies, showing the differences between broods of the same insect in the wet and dry seasons respectively, which had hitherto been generally regarded as distinct species.——Professor Packard desires specimens of Nola and of the Notodontians, with a view to preparing a revision of these groups of Bombycidæ.——L. R. Meyer Dür, a well known Swiss entomologist, died at Zurich, March 2d, aged 73. On November 28th, G. A. Keferstein died at Erfurt, aged 91, at the time of his death the oldest entomologist in Europe.

ZOÖLOGY.

Distribution of Color in the Animal Kingdom.—L. Camerano discusses this subject at length. Colors may be arranged in accordance with the frequency of their occurrence, thus: (1) Brown; (2) black; (3) yellow, grey and white; (4) red; (5) green; (6) blue; (7) violet. Black, brown and grey are more common in Vertebrata than in Arthropoda, while red and yellow are more generally met with in the lower forms. Green is very frequent in the lower forms, less so in Mollusca and still more rare in Vertebrata. Violet and blue are the colors most seldom met with, but they occur in all groups of the animal kingdom. White is irregularly distributed, but more characteristic of aquatic animals. The colors of animals bear a relation to the mediums in which they live; parasites are less varied in color than free-living animals. Aquatic animals are commonly more evenly and less brilliantly colored than land animals; pelagic animals, as might be predicted from their transparency, are not strikingly colored. Among birds the strongest flyers are most soberly tinted. Of inhabitants of the sea, those that live among Algæ are more vividly

colored than those which live under stones or on a sandy bottom; similarly land animals that inhabit forests are on the whole more conspicuous for their bright coloration than animals which live in deserts. There is no relation between the color of an animal and its food, as Grant Allen has asserted; insectivorous animals that live among plants and flowers have often varied and brilliant colors; on the other hand, herbivorous animals, if they do not habitually live among shrubs and herbs, are dull and uniformly colored. The development of color stands in no relation to light, but depends far more upon the condition of the animal; ill-health and insufficient food causes a diminution in the brilliancy of its coloration.

In very dry climates the colors appear to be darker, while the reverse is the case in damp climates. The various zoölogical regions of the earth are characterized by a certain dominant range of color in their inhabitants; grey, white, yellow and black characterize the animals of the palæarctic region; yellow and brown those of the Ethiopian; green and red are the prevailing tints of the neotropical; red and yellow, of the Indian region. Australia is distinguished from the rest by the great abundance of black animals.

In a given group of animals the larger species are usually more uniformly colored than the smaller. Sexual colors bear a general correspondence to the development of the animal; the males are mostly more brilliantly colored; in many cases, however, where the females are larger and stronger than the males, the former show the more brilliant coloration. Young animals are often differently colored to the adults, their colors are generally more like those of the adult female. The young of several species that are most dissimiliar in their colors, when adult are often hardly distinguishable in this respect.—*Journal of the Royal Microscopical Society, February, 1885.*

LIFE-HISTORY OF STENTOR CÆRULEUS.—Professor G. W. Worcester gives a detailed description of the development and life-history of *Stentor cæruleus*, which can hardly be satisfactorily abstracted. When first observed it appeared a motionless, intensely blue mass, containing what seemed to be a row of internal vacuoles, which later proved to be the moniliform endoplast of the mature infusorian. A larger vacuole was observed that subsequently became the mouth. The mass slowly changed its form, developing cilia at each extremity. The cilia eventually disappeared from one end, the shape was constantly varied, and in a little less than two hours it had put on the mature form, and was swimming very rapidly. Conjugation with another specimen was then observed, each fastening itself by its posterior end to some object, their backs meeting, when they would roll over each other till their anterior extremities met. Conjugation lasted some moments when the specimens separated and swam away. The individual

observed lost its bluish tint and became of a bronze color. About an hour and a half after the conjugation it stopped suddenly, assumed a flat spread-out condition, whilst at the same time large vacuoles appeared throughout its entire mass. In appearance it was amœba-like, and after a time small masses became detached and immediately assumed a globular form. The detachment of masses whilst in this amœba-like stage in other specimens was witnessed, as also their development into mature forms.

The main mass would in some instances disintegrate after portions had been detached to form new individuals, nearly all the granular mass flowing out and leaving a row of egg-like bodies, the exact nature of which the author was unable to determine; he considers, however, that in them begins the cycle of life.

In one instance the specimen under observation only partially disintegrated, "the ciliated part, and a little more," remaining intact, and subsequently reforming into a perfect individual. Reproduction by the formation of internal embryos was also observed, likewise the rarer method of fission proper.

Professor Worcester considers the primitive form to be that of a sphere, and that the series of later forms assumed are so taken on by the creature in order to adapt itself more fully to its environment. The posterior end would seem to be appended more for locomotion and for the purpose of fixing itself. Conjugation must in some way play an important part in the re-arranging of the protoplasm.—*Journal of the Royal Microscopical Society, December, 1884.*

A Nervous System in Sponges.—Dr. R. v. Lendenfeld describes the presence of nervous elements and ganglion cells in the heterocœlous sponges. In the Sycones the walls of the pores contain groups of spindle-shaped cells, mesodermal in origin, which are frequently connected with branched cells, apparently of a ganglionic nature. In the Leucones sensory cells are present, but not concentrated round the pores. They are scattered here and there in groups over the general ectodermal surface; no ganglion cells like those of Sycones were discovered. In the Ascones the ordinary ectodermic cells appear to perform also the nervous functions. These results clearly show that the calcareous sponges at least can no longer be considered as Protozoa.—*Jour. Roy. Micr. Soc., April, 1885, 253.*

Shells of Bivalves.—An investigation of the structure and development of the shells of a great number of Lamellibranchiates has led W. Müller (*Zoöl. Anzeiger,* VIII, p. 70) to distinguish two chief varieties. First, in those shells which are only here and there connected with the mantle, the organic substance of the mother-of-pearl is membranous. Second, in shells which are continuously grown to the mantle, the organic substance of the mother-of-pearl layer forms a net-work. Only Cyclas represents

the second group, the former comprises all other Lamellibranchs.

THE LATERAL LINE OF FISHES.—It is familiarly known that the name of "lateral line" has been given by ichthyologists to an organ which runs along each side of almost all fishes, extending from the head to the tail. It has been successively studied by Steno, Lorenzini, Petit, Redi, Leydig and Schulze, the latter of whom have indicated the true path to be followed for the discovery of the functions of this line, whilst they have almost completed the investigation of its anatomy.

M. de Sède, in a thesis recently maintained before the Faculty of Sciences at Paris, and reproduced in Cosmos les Mondes, gave an account of certain interesting experiments made for the purpose of elucidating the physiological functions of this curious organ.

The fishes selected for the experiment were first submitted to the action of an anæsthetic, and then underwent the operation of re-section of the lateral nerve, which excited no reflex action due to pain. When resuscitated the subjects were left at rest in a large bowl, and some days afterwards they were placed in a vast aquarium where everything is so arranged that a fish desirous of circulating freely must make use of all its tactile resources and means of guidance. Under these conditions it was observed that the fishes which had been operated upon moved only with great caution, and were almost always the last to arrive at the distribution of food. Thus it appears that a fish able to make use of its eyes, but deprived of its lateral line, experiences a certain difficulty in finding its way.

M. G. de Sède next sought to ascertain how a fish would act if it retained the use of its lateral line, but was deprived of sight.

Two perches were blinded by removal of the eye-ball. There remained to them, then, for guidance, merely the general sensibility of the integuments and the special impressionability of the lateral apparatus in question. These organs acquire in a short time a great delicacy, for the two perches, when placed in the general aquarium, were soon able so guide themselves without any difficulty.

But the question now arises as to what part of this steering power belongs to the general sensibility, and what to this lateral line? Further experiments solved this problem.

A barbel was blinded, and, by way of extra precaution, its filaments were amputated. Subsequently its lateral nerve was severed. As long as this fish—even though deprived of its eyes and beard—retained the lateral nerve it guided itself easily; but as soon as this nerve was severed, it remained persistently motionless.

Lastly, a perch, blinded and deprived of its lateral line on one

side only, was placed in the labyrinthine aquarium. It contrived to keep the non-mutilated side turned towards any obstacle.

These experiments leave no doubt as to the function of the lateral line. It is a very delicate organ of touch, adapted to the requirements of an aquatic life. It is sensitive to the faintest movement of the water, takes cognizance of the slightest displacements, and gives fishes continual information on the state of the medium in which they live.

Zoological News.—*Vermes.*—Mr. W. Bateson has contributed to the *Quart. Jour. Micros. Sci.*, an account of the early stages of the development of examples of Balanoglossus found at Hampton, Va. The adults agree very closely with *B. kowalevskii* of Agassiz, but as the development differs, the species cannot be identified. At no stage has the larva any superficial resemblance whatever to a Tornaria, such as is described by Agassiz as occurring in the development of *B. kowalevskii.* The eggs are elliptical and opaque, are fertilized outside of the body; divide into two, segment regularly and then form a hollow blastophore, enclosing a segmentation cavity. The gastrula is formed by invagination, the blastopore closes completely, a posterior transverse ring of cilia forms, and the body elongates and becomes marked out into regions. The mouth is a small pore in the ventral middle line of the anterior transverse groove; and the nervous system is formed by a segregation of epiblastic cells in the dorsal middle line of the collar, forming a cord lying immediately beneath the skin. The larva is always opaque, and creeps about in the muddy sand when hatched.

Cœlenterates.—According to R. von Lendenfeld, the *Crambessa mosaica* in Port Jackson is brown, while that of Port Philip is deep blue. The difference is caused by the presence of Zoanthellæ, parasitic algæ which may possibly be young stages of Laminarians, in the Sydney variety, which Mr. Lendenfeld names *Crambessa mosaica symbiotica*, because it has become associated symbiotically with an alga, and thus differs from the Melbourne form as lichens differ from fungi. Should the variety not be able to live without its parasite, it would be a new species. Huxley, in 1845, does not notice the brown color, and all previous authors, though they have collected the species near Sydney, describe it as varying in color from blue to gray. Our author asks whether the change has taken place since 1845?

Batrachians and Reptiles.—Professor E. D. Cope as one of the results of his studies on the batrachian and reptilian fauna of Mexico and Central America, which had been prosecuted by the use of material mainly placed at his disposal by the Smithsonian Institution, states that the total number of species described up to date is six hundred and ten, which is described as follows:

		Genera.	*Species.*	
Batrachia	Urodela	6	15	120
	Gymnophiona	4	7	
	Anura	31	98	
Reptilia	Crocodilia	2	3	489
	Testudinata	11	28	
	Lacertilia	42	184	
	Ophidia	92	274	

Mammals.—Dr. A. Günther (*Ann. and Mag. Nat. Hist.*, Dec., 1884), describes *Alcelaphus cokii*, a hartebeest, killed by Col. Coke, on the east coast of Africa, and *Gazella thomsoni*, from frontlets brought home by Mr. J. Thomson, from his recent trip to Mt. Kenia and Victoria Nyanza. Mr. Thomson also brought back a frontlet of *A. cokii*. Thomson's gazelle is marked with a distinct black lateral band, which is absent in the allied *G. grantii*, with which it does not mingle.——Mr. Caldwell writes that Platypus embryos are quite easy to get and he cannot understand why they were not obtained before. He has thirty blacks with him and they have found 500 Echidna in six weeks.——From a study of the cerebral convolutions of the Carnivora and Pinnepedia, Professor St. Geo. Mivart gives additional reasons for the threefold division of the forms into Cynoidea, Æluroidea and Arctoidea.. In a paper recently read before the Linnean Society, he called attention to the universal tendency among the Arctoidea to the definition of a distinct and conspicuous lozenge-shaped patch of brain substance defined by the crucial and pre-crucial sulci. This condition does not occur in any non-Arctoid carnivore, but is found in *Otaria gillespii* and *Phoca vitulina*, where it is small and much hidden. He adduced this fact as an important argument in favor of the view that the Pinnipedia were evolved from some Arctoid, probably Ursine, form of land carnivore. The brains of Naudinia, Galidia, Crytoprocta, Bassaricyon, Mellivora, Galictis and Grisonia, were for the first time described in detail. The Viverrina, judged by the cerebral characters, formed a very distinct group among the Æluroids.

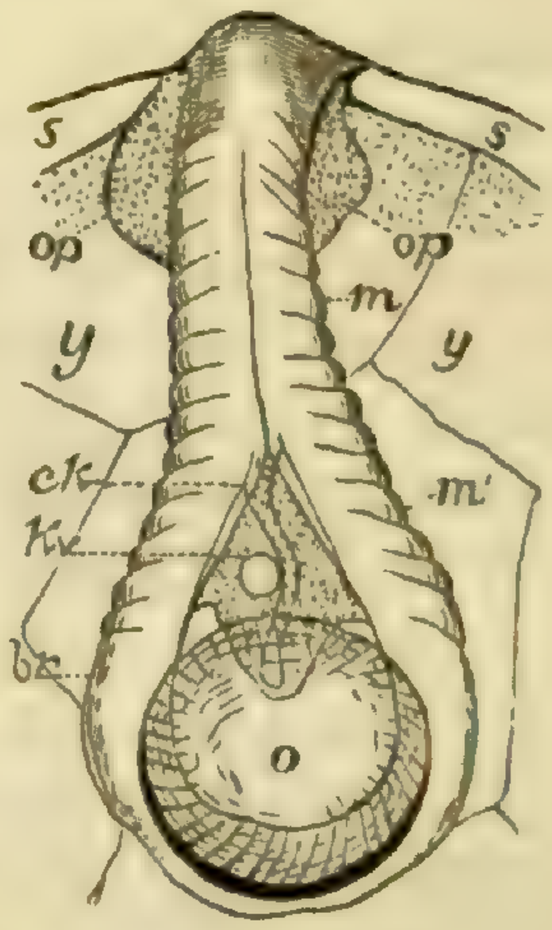
EMBRYOLOGY.[1]

On the Formation of the Embryonic Axis of the Teleostean Embryo by the Concrescence of the Rim of the Blastoderm.—During the season of 1881, I had an opportunity to study part of the developmental history of *Elacate canadus* at Cherrystone, Virginia. But unfortunately the lot of ova investigated by me did not develop to the period of hatching, but only passed a little beyond the stage when the blastoderm closes. As I have referred elsewhere to the very remarkable condition of affairs observed by me just previous to the closure of the blastoderm in this species, and not being likely to soon again have an opportunity to study the same form, I will now describe and figure what

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

was then observed in a number of ova, from which I infer that the peculiarity about to be described is charactistic of the development of this form. This species hatches in 24 to 36 hours.

The accompanying figure represents the embryo lying on the surface of the vitellus, and is represented as foreshortened, anteriorly the optic lobes, *op op*, on the other side of the vitellus show through the transparent yolk. The embryonic axis shows the segments or somites, *m*, distinctly developed, but it is very remarkable that the segmentation does not end at the point where the axis of the embryo so far formed ends. The right and left limbs of the blastodermic rim form a Λ-shaped mass, together with the embryonic axis anteriorly, but unlike any other normal teleostean embryo both these limbs of the rim are distinctly segmented for some distance as at *m'*.



Just within the yolk and a little in front of the yolk-blastopore, which runs forward into the acute angle formed by the limbs of the blastodermic rim, *br*, lies the large oil drop, *o*. A lozenge-shaped mass of cells lies in the acute angle of the Λ-shaped terminal part of the embryo, which appears to contain or overlie Kupffer's vesicle, *Kv*, and what was assumed to be the chorda, *ck*, at the time the observation was made, but of the certainty of this determination I am not at present satisfied. I was enabled to sketch this and a slightly more advanced stage several times, and as already stated found the same condition in a number of embryos, which seemed to be developing normally. Four other sketches show that the blastoderm finally closes very much as in other teleostean embryos and that pronounced wrinkles radiate from the crater-like opening upon the yolk where the yolk-blastopore finally disappears.

The conclusions of His and Rauber to the effect that the embryonic axis is formed by the gradual fusion from before backwards of the inner edges or the lips of the yolk-blastopore, as it advances over the surface of the vitelline globe, are in this case evidently correct, though it must be admitted that the presence of the cellular mass between the limbs of the blastodermic rim where they join the embryonic axis is not a little puzzling.—*John A. Ryder.*

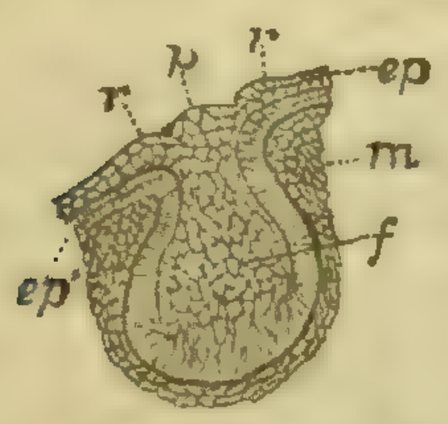
THE MODE OF FORMATION AND THE MORPHOLOGICAL VALUE OF THE EGG OF NEPA AND NOTONECTA.—In the last number of the *Zeitschr. für wissenschaftl. Zoölogie*, 1885, XLI. (p. 311), Ludwig Will has an article on this subject and reaches the rather startling conclusion that an egg-cell is not necessarily a simple protoplast, but may, while on the way towards the development of the ripe

egg, give rise to other cells In fact, the central chromatin body of the primitive egg-cell, which he calls the *oöblast*, ejects a large number of chromatin pellets from its substance which become the nuclei of the cells forming the egg-follicle. The conclusion at which Will arrives after reviewing the work of Fol, Roule, Sabatier, H. Ludwig, Balbiani and others, that in the ascidians, myriapods and insects, the nuclei of the follicular epithelium owe their origin to the primitive germinal nucleus or the oöblast, also holds good in respect to the ova of birds and amphibians, is of great interest, and stands in sharp contrast to the old view that, the ovi-cell and epithelial cells of the follicle were both originally similar elements (germ-cells), but which have merely developed farther in widely differents ways.

Will summarizes his results as follows: 1. The nuclei of the follicular epithelium are formed from the oöblast. 2. The residuum of the oöblast becomes the germinative vesicle of the egg. 3. Ova which are without a follicular epithelial investment, as is the case in numerous groups of animals, are homologous only with the egg plus the follicular epithelium of the higher forms. 4. The egg of the Hemiptera is neither a cell nor an assemblage of cells, but the *product* of several cells. 5. The homological value of the eggs of different types is to be found in the fact that, in every case the ripe egg represents a germinal mass, in which are contained all the capabilities of future development, and which is the *product* of the activities of those cells which have shared in its construction.

ON THE DEVELOPMENT OF THE MAMMARY GLANDS OF CETACEA.—The following is an abstract of an account of some researches just completed for publication upon this subject, founded upon materials in the U. S. National Museum.

In cutting longitudinal sections of the tail of a female embryo of *Globiocephalus melas*, two inches long, the microtome cut through the incipient mammary glands, one of which lies on either side of the external genital opening. The direction of the plane of section is nearly vertical and transverse judging from the appearance of the consecutive series. The accompanying cut will give the reader some idea of the appearance of these organs at the time they begin to be involuted or formed as thickenings of the epidermis of the young fœtus of these huge mammalia.



The outer corneous layer of the epidermis or epiblast, *ep*, and the lower layer of the latter on the Malpighian stratum, *ep'*, are alone concerned in the formation of the first rudiments of the mammæ, as in other mammalia. Although but a single stage was investigated, and not being aware of the existence of any previously published researches upon this subject, it has been thought best

to give my results together with such other information as could be gathered from the examination externally of the mammæ of a female whale's fœtus, five and a-half inches long, belonging to the Pacific genus Rhachianectes. The stage here figured displays the gland in the undifferentiated condition of the five-months' human embryo, when the gland consists merely of an involution of the malpighian layer, *ep'*, filled by a solid core of more rounded cells, *f*, which seem to become blended, at the lower end of the involution, with the Malpighian layer, the whole structure presenting the appearance of a solid pyriform body jutting down into the mesoblast, *m*, and connected with the epidermis externally by a narrow pedicel.

No signs of the outgrowth of the rudiments of acini from this pyriform body have yet appeared, but it would be inferred from the shape of the gland in the adults that these acini would be most apt to first appear at the anterior and posterior sides of this body. The gland in the adult cetaceans is greatly elongated, flat and less than one-third as wide as long, reaching the enormous dimensions of ten feet in length, three feet in width and eight inches in thickness in the adult, gravid female of *Balaenoptera sibbaldii*. In the adult the gland is also traversed longitudinally by a spacious lacteal sinus, which is probably developed during the growth of the gland by a process of vacuolization. This sinus opens externally through the nipple by way of a single duct. The gland therefore probably belongs to that subdivision of mammary organs provided with pseudo-nipples, which are developed by the production of the edge of the embryonic mammary area into a tubular teat traversed by a single canal as in the cow, certain marsupials and rodents.

In combination with the peculiar internal structure of the mammary gland of cetaceans, there is also an external teleological modification of a remarkable character, the nipple itself being lodged in a cleft or fossa, and concealed from view from without by a pair of longitudinal folds which close over it. From the evidence presented by my sections of the stage here figured of the development of the mammæ of Globiocephalus, when compared with the condition of these organs in the relatively older female embryo of Rhachianectes, already mentioned, it would seem probable that these folds were developed very early, as the nipple-rudiment or mammary area, *p*, has a fold on either side of it, represented in the figure by the elevations, *r r*, because in the larger embryo of Rhachiancetes the mammary fossæ are already developed, and there are no externally visible indications of nipples under or between the folds, the cleft being still very short in this specimen, or only about 0.5 millimeter, being absolutely minute as compared with the mammary fossæ of the adult, in which they must be over a foot in length.

It thus becomes evident that the mammary glands of cetaceans

develop at the start in much the same way as those of other Mammalia, but that their evolution is complicated somewhat by the early appearance of the folds on either side of the mammary area, which grow upward to form the sides and roof of the fossæ, which eventually enclose the nipples. The condition of the still earlier stages of the gland, judging from the general appearance of my sections, must be very similar to that observed in other mammals by Hüss, Langer, Kölliker and others.—*John A. Ryder.*

PHYSIOLOGY.[1]

Bacteria Literature.—Bacteria, by G. M. Sternberg, M.D. Wm. Wood & Co., N. Y., 1885; Micro-organisms and Disease by E. Klein, M.D., F.R.S., Macmillan & Co., 1884. English-reading students are to be congratulated that two such competent workers as are the authors of these books have not only given accounts of our knowledge concerning bacteria, but have described in sufficient detail their experimental methods so that the laboratory student has but to follow directions in order to enter the field of bacteria research.

Dr. Sternberg's work includes a translation of Megnin's Bacteria, in which are described the morphology, classification and physiology of the germ fungi. But the laboratory student will find particularly valuable the translator's original chapters on technology, germicides and antiseptics, bacteria in infectious diseases and bacteria in surgical lesions. Photo-micrographs form in part the illustrations of the book. To a worker the bibliography alone is more than worth the price of the book.

Photo-micrographs and how to make them, by the same author, is an elaborate and practical aid in this special branch of technology.

The work of Dr. Klein is a reprint of a series of articles which appeared first in the *Practitioner*. In addition to a clear account of methods of research the author gives a copiously illustrated description of the forms of bacteria and a consideration of their relation to disease. Especially valuable are the criticisms on such views as Buchner's concerning the transmutability of pathogenic and non-pathogenic forms.

Vaso-motor Nerves.—Recherches Experimentales sur le Système Nerveux Vaso-moteur, Paris, Masson, 1884, pp. 338. Under this title MM. Dastre and Morat collect and publish with considerable diffuseness the results of observations on the functions of the vaso-motor nerves already announced by them during the last five years.

This work does not strike the reader as a very keen criticism of disputed points in this difficult subject, nor is any considerable experimental ingenuity manifested. The method of exposition,

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Mich.

however, is admirable and the historical introductions might have been made of much value had the same attention been paid to the literature of other nations as has been given to that of the French. The authors study separately: 1. The innervation of the cutaneous blood-vessels. 2. The dilator-function of the grand-sympathetic. 3. The vaso-dilator nerves of the external ear. 4. The vaso-dilator nerves of the inferior limbs. 5. Influence of the blood of asphyxia on the nervous mechanism of the circulation. The authors are convinced that the slow rhythmic contractions which small arteries, as those of the rabbit's ear can be seen to undergo are not peristaltic, proceeding from the heart outwards, but involve the whole vessel simultaneously. In nearly all nerve trunks containing vaso-motor fibers, as the sciatic, the cutaneous and the sympathetic nerves, the vaso-motor filaments are of two kinds, vaso-dilator and vaso-constrictor. Efferent or centrifugal vaso-motor impulses, like ordinary motor discharges, all leave the spinal cord by way of the anterior spinal nerve roots; on the other hand all afferent or centripetal vaso-motor impulses enter the spinal cord through the posterior spinal nerve roots. The chemical condition of the blood determines largely the vaso-motor coördination between the vessels of the skin and of the viscera; asphyxia produces a dilatation of the vessels of the skin and a simultaneous contraction of those of the viscera. The direct action of dilator nerves traveling in the sympathetic can be demonstrated on the dog; stimulation of the sympathetic nerve in the neck causes flushing of the mouth and face on that side.

The most valuable part of the work is that which considers the vaso-motor functions of the sympathetic ganglia. The observations indicate that these ganglia are automatic vaso-motor centers from which impulses go out to the muscular coats of the vessels and keep them in a state of tonic contraction. Dilation or, on the contrary, stronger contraction of the vessels is brought about indirectly by either stimulation or inhibition of the activity of the appropriate sympathetic ganglia through impulses reaching these ganglia from the spinal cord along either vaso-constrictor or vaso-dilator spinal nerves. The physiological classification of nerves announced by Borden and by Bichat is still supported by fact; namely, that the cerebro-spinal system presides over the functions of animal life and of relation; while the sympathetic system is concerned with the nutrition and vegetative life of the body.

THE PHYSIOLOGICAL PURPOSE OF TURNING THE INCUBATING HEN'S EGG.—The setting fowl frequently turns her eggs during incubation and when this process is carried on artifically, mechanical means must be adopted to effect the same purpose. M. Dareste finds that during the first week of artificial incubation eggs which are turned develop in essentially the same manner as those which are allowed to rest, but the monstrosities which have already been

formed in the latter soon take on an excessive development and in very few eggs which are allowed to remain unmoved during the whole period of incubation does the body cavity of the embryo become closed in. The cause of death in the unmoved eggs is, according to Dareste, the union by growth of the allantois with the egg-yolk which latter is thus prevented from becoming finally absorbed into the alimentary canal preliminary to the closure of the body cavity. These adhesions of the allantois with the vitelline membrane lead to frequent rupture of the latter whose contents are thus largely lost to the embryo. Death of the chick in the unturned eggs usually occurs about the second week of incubation. When the eggs are turned over it is probable that the position of the allantois upon the yolk is shifted and this daily movement prevents adhesion between the two surfaces. Sixteen eggs were placed under the same conditions of artificial incubation, but eight were allowed to remain unmoved while the eight remaining were turned over twice a day. In the first set absorption of the yolk did not occur in any specimen, and all the embryos died in the course of the second or third week. In the second set, in six eggs the yolk was absorbed in the normal manner; in a seventh, opened on the twenty-second day, the chick was alive and hearty and the yolk was being absorbed; in the eighth egg the chick was dead on the twentieth day and adhesion between the allantois and yolk had prevented absorption of the latter.—*Comptes Rendus, 1884, p. 813.*

PSYCHOLOGY.

Psychical Research.—At the Birmingham Midland Institute in November last, Mr. W. H. Myers, M.A., gave a lecture on "Aims and Methods of Psychical Research." The lecturer began by dwelling on the difficulty which the religious and scientific world experience in finding a common ground on which to meet, and pointed out that neither party had made a serious attempt to test the real value of those scattered indications of a psychical element in man which actual experience offers us. He explained that the object of the Society for Psychical Research was to subject all these indications to a fair and unbiased examination on scientific lines. The experiments which had so far been tried consisted mainly in discovering persons of special sensitiveness, and subjecting them to certain influences, either of magnets, &c. (as in the experiments of Reichenbach, of Charcot), or hypnotic or mesmeric passes, or of mere expectant attention, this last possibly inducing some influence at present unknown, as in so-called spiritualistic séances. In the lecturer's view it was at present wholly premature to ascribe the last phenomena to the spirits of the dead. Whatever in them was not due to mere fraud, must wait for an explanation until the simpler phenomena connected with sensitives were much better understood. The lecturer then

explained the important discovery (due mainly to the society's experiments, and to those of Professor Barrett in the first place) that mental pictures, thoughts, and sensations can in some cases be transferred from one person to another without contact, and without the agency of any of the recognized organs of sense. Some diagrams were here exhibited, representing simple outline drawings, which had been drawn by one person and reproduced by another person who had not seen them, but into whose mind their image had apparently been projected by a strong concentration of thought. It was next shown that this theory of thought transference could be extended so as to explain many cases of apparitions at death, &c., of which some examples were given. The lecturer insisted on the importance of a very large collection, and a very careful sifting, of first hand narratives of apparitions, premonitions, &c., with a view of discovering the laws which govern such occurrences. The risks of error or exaggeration in these accounts were pointed out, and a warning was given against premature theorizing. The audience were requested to send to the secretary of the Society for Psychical Research, 14 Dean's-yard, Westminster, any well-attested narratives of apparitions, &c., which they could collect, and especially the records of any experiments in thought-transference, &c. The lecturer concluded by stating that, although the evidence hitherto collected could not be said to amount to a proof of the survival of the soul after the death of the body, yet, so far as it went, it pointed in that direction. The evidence of the materialist theory was simply negative. That theory might be likened to a pyramid set on its apex: it was in a state of unstable equilibrium, and the smallest amount of positive evidence against it was sufficient to overturn it as a scientific theory. He drew a picture of the probable effect on human life and character if that great hope were to be raised into scientific certainty, and to become a pervading and dominant belief. Towards such great issues psychical research seemed to be tending, though the work must be minute and laborious, and the result must be slowly won.—*English Mechanic.*

A Dog ashamed of Theft.—A Baltimore gentleman owns a skye terrier which recently proved that it could feel ashamed of a dishonest act. At the time in question the gentleman was seated at his table. The little Skye saw a cutlet near the edge of the board, and yielded to the temptation to steal the meat. The cutlet was slyly seized and taken under the sofa. The gentleman pretended not to see the act of theft. But the conscience of the little terrier soon got the better of its hunger. It brought the cutlet back, laid it the feet of its master, hung its head in shame and slunk away.—*Philadelphia Call.*

We never personally knew "old Rove" to steal, but we were informed that he did once steal a piece of corned beef from a

grocer in town. At home he never took a thing without asking for it, though legs of mutton have hung for days and days within his reach. But unfortunately we cannot say as much for "Floss," who however, will at once surrender anything taken, upon command; but we don't think that he *looks* as ashamed of the act as he ought to. He is no thief, however.

We have not a doubt that early and persistent training of a bright dog, commencing with him when only a few weeks old, would cultivate the moral side of his nature, as his intellectual side is trained and developed by his intercourse with man. But beating never brings about any such results.

The other evening we had turned "Floss" out into the barn, and when he returned through the well room we have no doubt he gave us notice he wished for water; but we did not observe it. As we passed into the kitchen we turned to close the door after the dog, and there he stood upon the threshold, with such a look of intense yearning coupled with astonishment on his face, that we at once recognized his demand and supplied him with water. We thought that if there was not soul behind that look, the Creator of us all had surpassed Himself in lighting up the cold clay with the light of life. We don't say it can't be done, but we do not believe it *is* done.—*Brunswick Telegraph.*

ANTHROPOLOGY.[1]

ANTHROPOLOGY AT THE NEW ORLEANS EXPOSITION.— Every allusion to anthropology in New Orleans should begin with Dr. Joseph Jones, author of the Smithsonian contribution entitled the Stone graves of Tennessee. Since writing this contribution Dr. Jones has utilized his leisure from an arduous profession to continue his researches in American archæology and in the various living problems which his position of president of the Board of Health brought before him. His splendid cabinet occupies one entire side of his house and contains nothing but the *chef d'oeuvres* of American aboriginal art. Dr. Jones has in his possession a relic which will interest active archæologists. At Selzertown, fourteen miles from Nachez, is a celebrated mound mentioned by Squier and Davis, covering about five acres of ground and about fifty feet high.

The top of the mound is truncated and the sides indicate that the structure was formerly a regular teocalli erection. Into this Dr. Jones drove a trench twenty feet horizontally and fifteen feet deep, coming upon cedar posts and charcoal mixed with ashes. Beneath these ashes was discovered a fragment of a French burr millstone weighing about eight pounds. Dr. Jones has preserved this fragment as an evidence of the late day at which the Nachez Indians erected their pyramidal mounds.

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

Abbe Roquet, in the Bishop's palace, is an excellent Choctaw scholar, speaking the language fluently. He is collecting material for a grammar and dictionary of that language.

In the New Orleans exposition almost every State and foreign government has exhibited something of the greatest interest to the anthropologist. From Maine we have basket and bark work of the Quoddy Indians. From Ohio, Indiana, Illinois, Missouri, Arkansas, Tennessee, North Carolina and a few other States there are very instructive private collections of antiquities. Louisiana exhibits one screen of the blow-tubes, basketry, bows and arrows and clothing of the Shetimasha Indians. Minnesota has a very large exhibit of sledges, birch bark work and Indian clothing. Nebraska, Dakota, Montana, Wyoming, New Mexico, Arizona, Nevada and California all exhibit the weapons, dress and implements of their modern tribes. The Greely relief relics attract a great deal of attention, including a great many articles illustrative of Greenland Eskimo life. In the government space are two anthropological exhibits. That of the Bureau of Ethnology contains the excellent models of Pueblos by the Mindeleff brothers, two Indian busts executed by Achille Collin, a fine group of potteries from Chiriqui and from the pueblos, and the superb cabinet of old pueblo pottery belonging to Mr. Thomas Keam, who also displays a large case of Moqui dance paraphernalia.

The Smithsonian exhibit contains a typical series of stone implements arranged by Dr. Charles Rau, and an educational series of modern Indian specimens covering the entire continent and including every category of savage culture.

The Mexican department cannot be too highly praised. In a store room at '45 Chartres street Mr. Abbadiano, a Mexican artist, has on exhibition a series of gelatine casts of celebrated Mexican antiquities for which he asks eight thousand dollars. The work in these far surpasses in delicacy that of M. Charnay in the Lorillard collection. It comes out also by examination that M. Charnay did not take the impression of the whole sacrificial stone but a group or two here and there and multiplied them to get the fifteen groups around the stone. Now in Abbadiano's cast of the whole stone it plainly appears that the second and fourth group to the left of the gutter contain women, and furthermore the ornaments on the persons of the captives are by no means all alike. M. Abbadiano's collection should find place in some great public institution, and it is to be hoped that he will succeed in placing it there.

The Mexican department proper contains about 700 cases, in every one of which something can be seen illustrative either of the old civilization of that country or of those interesting survivals and transitions which throw light upon the history of mankind. The native drinks from the yuccas and cactuses, leather

work textiles, figurines in costume, pottery, in fine, everything exhibited should find place in a permanent museum. The Mexican commission and government deserve the highest commendation for this interesting feature of the exposition. Even their musical exhibit in the celebrated band contained such instruments as the bandolon, salteria and timpanis, new to almost every visitor.

The Central American States of Guatemala, Honduras and Salvador also contains many objects of interest to the student of primitive culture, showing the continuance old Maya customs.

A great part of the Japanese exhibit is devoted to education in that country, and is designed to show not only the method of adopting new ideas, but the old customs are also set forth in quaint apparatus of older types. Quite a number of very primitive devices are also among the newer ones, lighting them up with excellent effect.

The Chinese department is devoted to showing the cotton industry in that conservative country. It is excellent. Here upon a series of wall screens is painted the whole operation from the planting to the wearing out. Around the space you see first a man ginning cotton with a little wooden thing that looks like a rude clothes wringer. Just beyond another is whipping it with a bowstring, and from point to point you are led by a series of dummies until the whole process is before you.

Of the vast arena for flying wheels and nice adjustments of machinery, the culmination of all those primitive arts which it is the delight of the anthropologist to trace, we have not space to say more than that its rythmic pulsations seem to beat time to the great song of human progress. Man has built no prouder monument to his conquest of nature than this busy, varied, noisy scene.

Dental Index.—It is quite probable that Professor Flower has hit upon a new and valuable index of race. In the Journal of the Anthropological Institute (xiv, 183) appears a paper of his on the size of the teeth as a character of race. As a test of the size of the teeth is taken " the length in a straight line of the crowns of the five teeth of the upper molar series *in situ*, between the anterior surface of the first premolar and the posterior surface of the third molar, which length is the *dental length* (*d*). For the divisor is taken the cranio-facial axis, or baso-nasal length (B N), the distance between the nasion (naso-frontal suture) and basion (middle of the anterior edge of foramen magnum). The index will therefore be $\frac{d \times 100}{B\ N} =$ *dental index.*

The result of applying this index will appear in the following tables:

	B N	*d*	Index.	Average index of both series.
Male gorilla, average of 3	124.0	63.0	50.8	54.1
Female gorilla, average of 3	108.7	63.3	57.3	
Male chimpanzee, average of 3	96.7	46.0	47.6	47.9
Female chimpanzee, average of 3	88.3	42.7	48.1	
Male orang, average of 4	109.2	58.0	53.1	55.2
Female orang, average of 2	90.0	51.5	57.2	
Male siamang, 1	79.0	33.0	41.7	

The races of men, as will be seen in the following table, may be divided into three classes by this index:

Microdont, below 42.

Mesodont, between 42–44.

Megadont, above 44.

Among the apes the first three species are megadont, while in the siamang the molar teeth are scarcely larger than in the higher races of men:

	Sex.	Observations	Average. B N	Average *d*	Average Index.	Aver'e Index both sexes.
Microdont Races.						
British	♂	20	100.0	41.0	41.0	41.3
"	♀	13	95.0	39.5	41.6	
Mixed European (not British)	♂	52	101.3	41.0	40.5	41.1
	♀	14	95.1	39.6	41.6	
Ancient Egyptians	♂	7	101.4	41.4	40.8	41.0
" "	♀	8	95.9	39.5	41.2	
Polynesians (mostly Sand'h Is.)	♂♀	22	105.3	42.2	40.1	
Low caste Cent. & S. India m'ly	♂	42	99.5	41.2	41.4	
Mesodont Races.						
Chinese	♂	12	98.8	42.1	42.6	
American Indians, all parts	♂	31	99.2	42.5	42.8	
Malays of Java, Sumatra, &c.	♂	70	99.7	43.2	43.3	
African Negroes, all parts	♂♀	44	103.3	44.5	43.2	
" " "	♀	26	97.9	43.6	44.6	
Megadont Races.						
Melanesians, various islands	♂	21	102.3	45.2	44.2	
Andamanese	♂♀	9	94.4	41.9	44.4	45.5
"	♀	8	88.8	41.2	46.5	
Australians	♂♀	22	102.5	45.9	44.8	45.5
"	♀	14	95.5	44.0	46.1	
Tasmanians	♂	9	100.0	47.5	47.5	48.
"	♀	4	95.5	46.5	48.7	

The Microdont races include all the so-called Caucasian or white races; the Mesodont the Mongolian or yellow races; the Megadont the black races, including the Australians. In the case of the Polynesians and African Negroes the index is reduced by

the greater length of the *basis cranii.* It may not be premature therefore to say that the species *homo sapiens* is divided into three sub-species as follows :

Microdont subspecies.
Mesodont subspecies.
Megadont subspecies.

We may then reserve the term *race* for those actual grand divisions of humanity, twelve or fifteen or more, as the case may be, resulting from the crossing of these sub-species.

MICROSCOPY.[1]

THE USES OF COLLODION.—In modern histological technique collodion has come to serve a variety of important purposes. Duval[2] was the first to call attention to its advantages as an imbedding mass. He found that it penetrated preparations easily and thoroughly ; that it could be quickly brought to the proper degree of hardness in alcohol of 36° (80 %); that objects thus imbedded could be preserved in this alcohol for an indefinite length of time; that the imbedding mass preserved its transparency, so that the preparation could be easily examined; that the sections did not require to be freed from the mass, since they could be colored and mounted in glycerine, and the mass remain unaffected by the process.

As soon as Duval's discovery became known, Merkel and Schiefferdecker[3] began to experiment with collodion, and greatly improved and extended its use.

It was found desirable first of all to be able to vary the concentration of the collodion, an end very conveniently reached by Merkel through the use of a solid preparation, called *celloidin*, which he dissolved in absolute alcohol and ether in equal parts.

Duval mounted sections of objects imbedded in collodion in glycerine, and was unsuccessful in his experiments with balsam. Schiefferdecker has shown that by dehydrating the sections with 95 per cent alcohol, and clarifying in oil origanum or oil of bergamot, the sections could be mounted in balsam (" Microscopy," Aug., 1884, p. 843).

Some improvements of minor importance in the process of imbedding have been made by Thoma, Blochmann and others.

The importance of collodion in microtomy was much increased by the discovery that in combination with clove oil it could be used as a fixative for serial sections, and that the latter could be colored *after* they had been arranged and fixed on the slide. This invaluable method, discovered by Schällibaum,[4] presents all

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.
[2] Journ. de l'anat. et de la physiol., XV, p. 185, 1879.
[3] Arch. f. Anat. u. Physiol., Anat. Abth., p. 199, 1882.
[4] Arch. f. mik. Anat., XXII, p. 689, 1883.

the advantages of the shellac method of Giesbrecht, and offers, at the same time, the best means of meeting the difficulties of staining objects in toto. The only other fixative thus far known which claims to accomplish similar results is that introduced by Mayer ("Microscopy," Feb., 1884).

Prof. Gage,[1] who began to experiment with collodion as a fixative prior to the publication of Schällibaum's method, has given some valuable directions respecting its preparation and application. Gage applies the collodion and clove oil separately, first coating a number of slides with collodion, which is poured on to one end of the slide and allowed to flow quickly over it and off into the bottle; and then, at the time of using, adding a wash of clove oil. In order to remove any cloudiness that may arise in the collodion film, a little clove oil is added to the balsam.

The use of collodion to prevent the crumbling of brittle sections originated with Norman N. Mason.[2] The same method was employed in Semper's laboratory by Timm,[3] Will,[4] Sarasin,[5] Sharp and others; and Mark has found it indispensable in sectioning the ova of Lepidosteus. Mason applied the collodion by means of a fine brush, taking up a small drop and placing it "in the center of the object so as to allow it to flow out on all sides to prevent the formation of air bubbles. After being allowed to harden a minute, the section may be cut and placed on the slide *with the film of collodion underneath.*"

Mark and others who have used collodion for the same purpose, simply paint the cut surface of the object with a thin film a few seconds before making each section.

Celloidin Injections.—In the formation of injection masses collodion plays still another important role, for the discovery of which we are indebted to Schiefferdecker.[6] It can be made to penetrate easily very fine blood-vessels, and its viscosity protects them against injury; its application is simple and easy, and in all these respects it is said to be superior to the masses hitherto employed for "corrosion preparations." It has a slight shrinkage, but not enough to form a serious drawback. It is prepared in different ways according to the color to be given to the injection.

A. Asphalt Celloidin Injection.—1. Pulverized asphalt placed in a well closed bottle of ether and allowed to remain twenty-four hours, during which the mixture must be several times shaken.

2. The brown-colored ether is turned off, and small pieces of celloidin dissolved in it until the solution flows like a thick oil.[7]

[1] The Medical Student, p. 14, November, 1883.
[2] AMERICAN NATURALIST, 1880, p. 825.
[3] Semper's Arbeiten, VI, p. 110, 1883.
[4] Semper's Arbeiten, VI, p. 7, 1883.
[5] Semper's Arbeiten, VI, 1883.
[6] l. c., p. 201.
[7] The pulverized asphalt can be used many times over for coloring the ether, as very little of it will dissolve in twenty-four hours.

B. Vesuvian Celloidin Injection.—1. Make a saturated solution of Vesuvian in absolute alcohol.

2. Dissolve in this pieces of celloidin until the desired consistency is reached. The brown injection thus obtained is less satisfactory than that formed from asphalt, as its color fades somewhat.

C. Opaque Celloidin Injections.—1. Dissolve celloidin in absolute alcohol and ether in equal parts.

2. Add vermilion or Prussian blue to color.

The coloring substance should be mixed with a small quantity of absolute alcohol and then reduced to great fineness by continued trituration in a mortar. To the thick paste-like mass thus obtained the solution of celloidin is next added. The amount of coloring substance should be as little as possible, as the mass will otherwise be too brittle. If a fine injection is required the mass should be filtered through flannel moistened with ether. The syringe employed must be entirely free from fatty substances, as these render the injection mass brittle. If the piston does not fit the syringe tube sufficiently closely, it may be wound with a little gauze. The cannula should be filled with ether before it is inserted and tied in place, and again filled just before it is joined to the syringe.

In using a mass dissolved in alcohol and ether it is well to add a little ether, which will spread over the surface and thus prevent the formation of a film. The injection should be made moderately quick, as the mass stiffens soon after contact with the tissues. After injection the syringe and cannula should be cleansed with ether.

The injected organ is placed in hydrochloric acid, diluted more or less according to the danger of shrinkage. It is left in the acid, which is occasionally renewed, until the tissues are sufficiently corroded to be easily washed away by a slow and steady stream of water, conducted through rubber tubing connected with a water-pipe. The preparation may then be left in water for some days or weeks in order to free it from remaining fragments of tissue by gradual maceration. The preparation when finished, may be preserved either in glycerine or a mixture of glycerine, alcohol and water in equal parts.

The asphalt-celloidin mass is the one most highly recommended by Schiefferdecker.—*C. O. Whitman.*

Notes on Section Cutting.—My only apology for the present communication is the hope that it may prove a saving of time to those who have encountered the difficulties of cutting eggs which are composed largely of yolk corpuscles liable to crumble in the ordinary paraffine method. The difficulty I have experienced lies not alone in the impossiblity of making sections—even from eggs very thoroughly permeated by the paraffine—which

will not crumble during the removal to the prepared slide, but also in the fact that sections successfully transferred to the slide are liable to have portions of the yolk granules loosened and floated over other portions of the sections during the removal of the paraffine. While by the ordinary methods of mounting (Geisbrecht, Schällibaum) those elements of the section which lie on its *under* side, and therefore come in immediate contact with the fixative, are safely held in place, it may happen that many from the *upper* surface are loosened and washed away, because the fixative does not penetrate the whole thickness of the section.

This obstacle may be entirely avoided by the proper use of collodion.

We are indebted to Mason,[1] so far as I am aware, for the first suggestion of the use of collodion in this connection. But the method employed by Mason has serious objections. A *drop* of collodion on the surface of a paraffine-imbedded preparation softens the object to such an extent that cutting is a very slow process, and thin sections are not easily attainable. The thickness of the collodion film, moreover, interferes more or less with accurate study of the mounted object, even if the sections are inverted when applied to the slide. The gradual drying of the surface of the film also causes the section to roll into a hollow cylinder with its collodion surface innermost, so that the inversion of the section becomes difficult if not altogether impossible. The consistency of the collodion to be used is stated by Mason, but this is of little value since even a short exposure to the atmosphere often repeated will quickly change the condition of the collodion in the bottle.

All these impediments—but for which the method, I believe, would have come into more general use—may be largely if not entirely obviated by using *a very small amount of a rather thin collodion.*

The criterion which serves me is: *the collodion must dry almost instantly* (within two or three seconds after being applied) *without leaving a trace of glossiness on the surface of the paraffine.*[2]

In this collodion process I use at present the following method:

The object imbedded in paraffine in the ordinary way is placed in a receiver of a Thoma's microtome and the paraffine cut away to within 1^{mm} to 2^{mm} of the object on four sides,

[1] N. N. Mason, Use of Colloidion in Cutting thin Sections of Soft Tissues. AMER. NAT., Vol. XIV, p. 825, Nov., 1880.

[2] Judging from the effects, I am inclined to think that by this method the collodion penetrates the preparation to a certain depth, fixing the parts in their natural relations without producing a superficial film. At any rate, if the sections are made sufficiently thin (e. g. 5μ) there is no curling, whereas with much thicker sections, the superficial portion of which alone contains in that case the collodion, there is often a tendency to roll. This I have attributed to the slight shrinkage in the upper or collodion-impregnated portion of the section.

leaving a rectangular surface of paraffine, two edges of which are parallel to the edge of the knife.

A slide prepared by being painted with *a thin coat* of Schällibaum's mixture of collodion and clove oil is placed at the left of the microtome.

At the right of the latter, handy to the right hand, is a small bottle half full of the thin collodion, into which dips the tip of a camel's hair brush; the quill of the brush is thrust through a hole in a thin flat cork which serves at once as a temporary cover to the bottle and a support to the brush, the latter being adjusted to any height of the collodion by simply shoving it up or down through the hole in the close-fitting cork. Near by is a small bottle of *ether* with which the collodion is thinned as soon as it begins to leave a shining surface on the paraffine.

The operator should sit *facing the light*, so that he may judge accurately of the condition of the surface of the paraffine, which reflects the light. Everything being in readiness the brush is lifted and wiped on the mouth of the bottle to *remove the most of the collodion*, and then the paraffine and object are *at once* painted by *quickly drawing the brush across the surface*, care being used that it is evenly applied and that the collodion is not carried on to the vertical faces of the block. The temporary moistening vanishes like a cloud from the surface of the paraffine, the brush is returned to the bottle at once; the knife is drawn and returned, leaving the section on the edge of the blade. The object in the block is then painted again, but before drawing the knife a second time the first section is removed with a scalpel and placed on the slide with its *upper face in contact with the fixative*. Then the knife is drawn again, and the other steps of the process repeated. Thus the collodion has time to thoroughly dry before the section is made. But if the precautions above given are observed, it will not be necessary to wait for the drying of the collodion and the section may therefore be cut at once, *i. e.*, within five seconds after painting. It is thus possible to cut as fast as one can paint the surface, and with some practice it becomes possible to cut *continuous ribbons* of sections which may be transferred at intervals. Practically I find it most convenient to cut enough to form one row or half a row of sections at a time and transfer at once to the slide, rather than to cut the whole object without interruption as is done in the ordinary method.

The following precautions may prove serviceable: Especial care should be exercised to prevent the painting of the vertical face nearest the operator, since the section is then liable to cling along its whole edge to this vertical film and be carried *under* the knife blade. If by chance this should occur, the section should be removed from the block *before the knife is shoved back*, as it is liable to be caught and lacerated between the face of the block and the under surface of the returning blade. The possibility of

the section being thrown under the knife blade, may, however, be obviated either by carefully trimming the vertical face in case it is accidentally painted (to allow for which the *hither margin* of the paraffine may be left broader than the other three), or by drawing the knife *slowly*, so that the first indication of a failure to cut through the vertical film may be recognized and the section held in place on the blade by a slight pressure with a soft brush, whereupon the knife will cut through the film and leave the section free.

If by chance the paraffine block has been painted with too much collodion or with collodion which is too concentrated, thus leaving a shiny surface, the film should be at once broken by pressing it gently two or three times in quick succession with the end of a rather stiff, blunt, *dry* brush. This enables the collodion to dry quickly and thus prevents the softening of the paraffine.

If the sections have a tendency to curl they may be flattened out on the slide by means of a brush, for a section thus impregnated with collodion may be handled during the first few seconds after contact with the Schällibaum mixture with much greater impunity than one not so treated. If the collodion has been too much thinned with ether, the fact will become apparent from the softening of the paraffine, and may be remedied by waiting for the evaporation of the ether, or by adding thicker collodion.

This process can be in no way considered as a substitute for the ordinary method of cutting objects since it requires more time and closer attention to details, but for those cases where there is a liability to crumbling, or where sections of sufficient thinness cannot be procured free from folds, it will doubtless be found very serviceable.—*E. L. Mark, Mus. Comp. Zoöl., Cambridge, Jan., 1885.*

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SCIENTIFIC NEWS.

— At a late meeting of the Liverpool Microscopical Society, Mr. A. Norman Tate read a paper, which is reported in the *English Mechanic*, on the microscopical examination of potable water. After alluding to the impossibility of always determining by chemical means alone whether a water is or is not fit for dietetic purposes, he proceeded to speak of the importance of microscopical investigation in relation to water-supply, pointing out that it afforded better opportunity of determining the character of organic impurities, and that it might frequently assist in ascertaining the character of the mineral constituents. He considered the arbitrary standards of purity as regards organic constituents, set up by some water analysts as being unsafe to use, without knowing the exact nature of such matters. And in deciding this the microscope could help. He then proceeded to speak of in-

vestigations concerning the minute animals and plants in waters contaminated with sewage, &c., and then described different modes of collecting and examining waters microscopically, and urged the importance of further investigation, so as to ascertain how far the organized matters present in water are capable of developing disease, and how such organisms may be destroyed by various means, describing several modes which might be adopted in carrying out such inquiries. In conclusion he mentioned impurities found in natural ice, and also two methods of examination of rain and air.

— In the death of Th. C. von Siebold, at the age of 80, Germany has lost one of her foremost biologists, while as a comparative anatomist he has held a prominent position for over fifty years. He will be remembered for his Comparative Anatomy of the Invertebrates, which was translated into English by Burnett in 1854, and is still nearly indispensable; for his fruitful labors on parthenogenesis in bees, saw-flies, moths, the Branchipodidæ and Apodidæ, his work on the Salmonidæ and their hybrids, and on intestinal worms, which made him second to none of the biologists of Europe, not even excepting Darwin. He was, with Professor Kölliker, the founder of Siebold and Kölliker's *Zeitschrift für wissenschaftliche Zoologie*, a journal which has done more than any other to elevate the tone and spirit of biological research. He was a most unaffected man, most cordial in his reception of young men, and he died at Munich full of honors.

— The Official Gazette of India reports that in 1883 the number of persons killed by wild beasts and poisonous snakes were 22,905, against 22,125 in 1882. 20,057 deaths were due to the bites of poisonous animals; 985 persons were devoured by tigers, 287 by wolves, and 217 by leopards. The loss of cattle amounted to 47,478 animals, an increase of 771 over the preceding year. While most of the deaths of human beings was due to the bite of snakes, only 1644 cattle were thus poisoned. More than three-quarters of the deaths took place in Bengal and in the provinces of the north-west. 19,890 dangerous animals were killed during the year.

— In a recent memoir by F. A. Forel on the deep fauna of Swiss lakes, he corrects the facts and theories which he had previously advanced on the origin of the blind Gammarus and Aselus of the deep parts of the lakes. Formerly he attributed them to direct emigration from a littoral fauna, which, penetrating into a region devoid of light, had there lost the visual organ and pigment. New researches have now led him to conclude that these blind animals have descended from cave-inhabiting forms which had already become differentiated in the dark subterranean waters.

— The April number of the Journal of the Royal Microscopical Society contains Rev. Mr. Dallinger's notable address on the life-history of the monads, illustrated by three excellent plates. He concludes that the vital processes in these lowest organisms are as "orderly, rigid and immutable as in the most complex organisms," though as in higher animals allowing free scope to the action of natural selection.

— The *Annals and Magazine of Natural History* for January last publishes an article from the *Illustrated Melbourne Post* for Sept. 24, 1864, in which it is stated that about ten months previous an Ornithorhynchus laid "two eggs which were white, soft and without shell."

— ERRATA.—In Vol. XVIII, p. 1259, and Vol. XIX, p. 277, it is stated that two trilobites have been discovered in the Cretaceous rocks of Australia. This is an unfortunate error which our readers will please correct.

P. 293, lines 10 from top and 2 from bottom, for emarginate *read* marginate.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

NATIONAL ACADEMY OF SCIENCES.—This body met in Washington, D. C., April 21st. The following papers were read:

1. Methods of measuring the cubic capacity of Crania, by J. S. Billings and Dr. Matthews, U.S.A. 2. On winged insects from a palæontological point of view, by S. H. Scudder of Cambridge, Mass. 3. On the Syncarida, a hitherto undescribed group of extinct malacostracous Crustacea, by A. S. Packard of Providence, R. I. 4. On the Gampsonychidæ, an undescribed family of fossil schizopod Crustacea, by A. S. Packard of Providence, R. I. 5. On the Anthracaridæ, a family of Carboniferous macrurous decapod Crustacea, allied to the Eryonidæ, by A. S. Packard of Providence, R. I. 6. On the coral reefs of the Sandwich islands, by Alexander Agassiz. 7. On the origin of the fauna and flora of the Sandwich islands, by Alexander Agassiz. 8. On the classification of natural silicates, by T. Sterry Hunt of Montreal, Canada. 9. On the cause of the progressive movement of areas of low pressure, by Elias Loomis of Yale College. 10. On the ratio of the meter to the yard, by C. B. Comstock. 11. An account of certain stars observed by Flamsteed, supposed to have disappeared, by C. H. F. Peters, Hamilton College, N. Y. 12. On the submarine geology of the approaches to New York, by J. E. Hilgard and A. Lindenkohl. 13. A biographical notice of the late Dr. J. J. Woodward, U.S.A., was read at this meeting by J. S. Billings. 14. The orders of fishes, by Theodore Gill. 15. On the organization of the tribe, by J. W. Powell. 16. On certain lunarine qualities due to the action of Jupiter, and discovered by E. Nelson, by G. W. Hill. 17. On the Pretertiary Vertebrata of Brazil, by E. D. Cope. 18. On the phylogeny of the placental Mammalia, by E. D. Cope. 19. On some recent observations upon the rotation and surface markings of Jupiter, by C. A. Young. 20. On the value of the Ohm, by H. A. Rowland. 21. On the vanadium minerals: Vanadinite, endlichite and descloiz-

ite, and on iodyrite, from the Sierra Grande mine, Lake valley, New Mexico, by F. A. Genth and Gerhard von Rath. 22. On the total solar eclipse of August 28th, 1886, by A. N. Skinner (by invitation). 23. On the evolution and homologies of the flukes of Cetaceans and Sirenians, by Theodore Gill and John A. Ryder. 24. Biographical notice of Gen. A. A. Humphreys, U.S.A, by H. L. Abbot. 25. Chemical action in a magnetic field, by Ira Remsen. 26. On the measurement of hearing power, by A. Graham Bell. 27. On the possibility of obtaining echoes from ships and icebergs in a fog, by A. Graham Bell and Mr. F. Della Torre. 28. Biographical notice of William Stimpson, by Theodore Gill.

The following gentlemen were elected members of the council: Professors Gibbs, Baird and Young, Gen. Meigs, and Messrs. Hilgard and Scudder. The following gentlemen were elected members: Henry Mitchell, Wm. A. Rogers, Edw. S. Holden, F. W. Putnam, Arnold Hague.

AMERICAN GEOGRAPHICAL SOCIETY, April 11.—Hon. John W. Hoyt delivered a lecture entitled Wyoming: its resources and wonders (illustrated by stereopticon views).

BIOLOGICAL SOCIETY OF WASHINGTON, April 4.—The following communications were made: Professor C. A. White, On vegetable cells; Mr. Frank H. Knowlton, remarks on some Alaskan willows and birches; Dr. Frank Baker, Muscular equalization.

April 18.—Dr. D. E. Salmon and Dr. Theobold Smith, Koch's method of isolating and cultivating Bacteria, as used in the laboratory of the Bureau of Animal Industry; Mr. A. B. Johnson, The shipworm and the sheeps-head; Mr. G. Brown Goode, Remarks on the velocity of animal motion; Mr. Romyn Hitchcock, Exhibition of a preparation of the "comma Bacillus" of cholera.

May 2.—Dr. Thomas Taylor, The white rust of cabbages, *Cystopus candidus* (with illustrations); Mr. H. W. Henshaw, hybrid quail; Mr. W. H. Dall, Notes on a journey in Florida.

NEW YORK ACADEMY OF SCIENCES, April 6.—George F. Kunz made some general remarks on the mining and cutting of gems (illustrated with a series of lantern slides).

April 13.—The language of the ancient Egyptians and its monumental records (illustrated with lanterns), by Dr. Charles E. Moldehnke.

April 20.—Professor D. Cady Eaton lectured on the Canterbury cathedral.

April 27.—Cotton in Brazil: its history, methods of cultivation and the insects affecting it, by Mr. John C. Branner; Mr. G. F. Kunz presented some brief notes on a remarkable meteorite.

May 4.—Notes on building stones: No. 2, Limestones, by Dr. Arthur H. Elliott.

BOSTON SOCIETY OF NATURAL HISTORY, April 1.—Professor G. F. Wright gave an account of his latest investigations upon the

terminal moraine from the Atlantic to the Mississippi, describing also the buried forests in Southern Ohio, and the terraces of the Monongahela and Allegheny rivers, supposed to be connected with the ancient ice dam at Cincinnati (numerous original stereopticon views were shown in illustration); Mr. S. H. Scudder spoke of the geological history of insects.

April 15.—Mr. Percival Lowell read a paper on the mythology of the Koreans (stereopticon views were shown in illustration).

May 6.—Mr. George H. Barton gave an account of the ancient land-system of the Hawaiians.

APPALACHIAN MOUNTAIN CLUB, May 13.—A paper by Mr. F. H. Chapin, on An ascent of the Rothhorn was presented; Mr. S. H. Scudder gave an account of a winter excursion to Tuckerman's ravine.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, March 3.—Mr. Meehan called attention to a specimen of *Cypripedium insigne* which had developed two flowers instead of the usual one, and was thus on the way toward a spicate inflorescence. The upper three-lobed petal had also become one-lobed, and the labellum in the upper flower was only twice instead of three times, the length of the column. Mr. Meehan considered such changes as nature's efforts to establish new forms.

Dr. Leidy had recently received from Florida remains of a species of Rhinoceros, including the crown of the last upper molar. The latter indicated a species not before described. which he proposed to name *Rhinocerus proterus.* The speaker expressed his belief that Dinoceras Marsh, was equivalent with Uintatherium Leidy.

Mr. A. H. Smith gave an account of a boring on Black's island, below Fort Mifflin, Delaware river. The boring passed through the following deposits. Alluvial mud seventy-five feet; dark gravel, six feet; white tenacious clay, two feet; beach-sand forty-seven feet; gravel, two feet, and then again beach-sand.

Professor Heilprin thought that, in the light of this boring, the beach-sand might be cretaceous. The same speaker then read a continuation of his paper on disputed geological and palæontological points.

March 10.—Dr. Leidy exhibited the upper molar tooth of a Hippotherium, belonging to an animal of about half the size of the horse. The example was from Florida, and in the same collection with it were some fossil crocodile bones, and the end of the phalanx of an extinct llama or camel, probably indicating new species.

Professor Heilprin stated that he had made a careful microscopic examination of the sand from the boring below Fort Mifflin, but had found no traces of Foraminifera. The roundness of the grains might indicate sea-sand.

AMERICAN PHILOSOPHICAL SOCIETY, Sept. 19, 1884.—The Secretary presented a series of thermometrical observations taken at Quito, Ecuador, between Sept. 17, 1858, and June 18, 1859, by Mr. C. B. Brockway.

Oct. 3.—Mr. Wall exhibited a full-size canvas tracing of a large group of Indian pictures cut on the top and sides of a half-buried block of sandstone, lying near the bluff of the Monongahela valley, in Fayette county, Pa., 290 feet above the river. Photographs of this and also of carvings on the shore of the same river, near Geneva, and of a carved rock on the Evansville turnpike, West Virginia, were also exhibited.

Mr. Lesley read a paper upon the possible origin of the double crown of Egypt; and also exhibited a square pipe of limonite, deposited against the walls of a vertical drain at the Eagle shaft, near Pottsville.

Dr. Syle presented a Chinese translation of Herschell's Outlines of Astronomy, published at Shanghai, Dec., 1859.

Oct. 17.—Dr. D. G. Brinton presented a communication upon the language and ethnographic position of the Xinka (Shinka) Indians, with two vocabularies of three dialects. Mr. Ashburner read some notes upon the origin and dimensions of the Natural Bridge of Virginia. A communication upon the doubtful character of Professor Lewis's alleged continuous range of trap through Southern Pennsylvania, was made by Dr. Frazer.

Nov. 7.—Dr. Syle made a verbal communication on the structure of the Chinese language and exhibited copies of the Shanghai Chinese *Illustrated News.* Professor Cope presented a paper by Miss Helen C. D. Abbott, entitled An analysis of the bark of the *Fuquiera splendens.* Professor Cope proposed to communicate A revision of the Reptilia and Batrachia of Mexico and Central America.

Nov. 21.—J. J. Stevenson presented Notes on the geological structures of Tazewell, Russell, Wise, Smith and Washington counties, Virginia; and Professor Daniel Kirkwood read a communication upon The limits of stability of nebulous planets.

Dec. 5.—Professor J. J. Stevenson communicated Notes on metamorphism; Dr. P. Frazer exhibited and explained his invention of an improvement on the pocket compass; and Mr. Ashburner exhibited a new map of the anthracite region.

Dec. 19.—Professor Cope read by title Twelfth contribution to the herpetology of Tropical America.

Mr. Ashburner communicated some notes on the recent publications of the Second geological survey of Pennsylvania.

PLATE XXI.

Percé Rock.

THE AMERICAN NATURALIST.

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EVOLUTION IN THE VEGETABLE KINGDOM.

BY LESTER F. WARD, A.M.

THE law of biologic evolution (for it is no longer a mere "doctrine") may be regarded as fairly established, no large and respectable body of scientific men being any longer found to oppose it when stated in its most general form, while difference of opinion and discussion have narrowed down to the more special aspects and minor details. In the animal kingdom, where organization is generally so high and structure so definite, great progress has been made in discovering the particular lines along which development has taken place and something like a true genealogy of the existing types has been worked out. The law of phylogeny is abundantly established by palæontology and surprisingly confirmed by embryological ontogeny.

In the vegetable kingdom this last important class of evidence is almost wholly wanting, and palæontological evidence, owing to the lower structural rank of plants, is far less complete and convincing than in the animal.

It is proposed in this article briefly to inquire what vegetable palæontology has to present in favor of evolution in plants. The subject may be considered under three somewhat distinct points of view, the historical, the geological and the botanical.

I. HISTORICAL VIEW.

It is a common observation that botany is far behind zoölogy in supporting advanced biological theories. This is still more strikingly true of the study of extinct than of that of living forms, for not only were the ancients wholly unacquainted with any form of vegetable petrifaction, although familiar with fossil shells,

madrepores and other animal remains, but when at last the era of science dawned toward the close of the eighteenth century Blumenbach had for many years been sounding the key-note of palæontological truth in the animal kingdom before Schlotheim took up the refrain in favor of plants.

When we consider the present state of knowledge respecting the geological strata of the earth's crust, we can scarcely realize that but two generations ago comparatively nothing was known on this subject. Geology was not yet born. The investigators of the last century were really not discussing the geologic age of fossil remains. With those who studied fossil plants the assumption was universal that they were plants that grew somewhere in the world only a few thousand years ago at most, plants such as either grew then in the countries where their remains were found or in other countries from which they had been brought by one agency or another, generally that of the Flood, or else, as some finally conceived, had been destroyed by these agencies, so as to have no exact living representatives.

In the year 1804 appeared Baron von Schlotheim's "Flora der Vorwelt," as it is now universally quoted, although the author himself merely entitled it a "description of remarkable plant impressions and petrifactions—a contribution to the flora of the former (or primeval) world." To us this seems modest enough, but in view of the history of palæontology, the second part of this title amounted to a bold declaration, and accordingly we find him defending it in his introduction by these words: "The petrifactions which so early engaged the attention of investigators, and which, without doubt, afforded one of the first incentives to the founding of mineral collections and to the earnest study of mineralogy and geology, have, as is well known, since Walch began to arrange them systematically, been for a long time, as well in as out of Germany, almost wholly neglected. They were content to regard them as incontestable proofs of the Deluge, which closed all further investigation until they were at last compelled to explain their occurrence through other great natural operations which had probably been going on earlier and more universally than the flood described in the Bible, and influencing the formation of the upper strata of the earth's crust; and more recent observations and investigations have even led us to the very probable supposition that *they may be the remains of an*

earlier so-called pre-Adamitic creation, the originals of which are now no longer to be found. * * * In the continued investigation of this subject this opinion, with certain restrictions, has in fact gained a high degree of probability with the author of the present work, so that he ventures to announce his treatise as a contribution to the flora of the ancient world (Vorwelt)." Since its introduction by Schlotheim this expression, "Flora der Vorwelt," has been applied to nearly all the German works on fossil plants, and "Beiträge zur Flora der Vorwelt" still continue to appear.

This work was followed, though sixteen years later, by his "Petrefactenkunde," and also by Count Sternberg's important "attempt at a geognostico-botanical presentation of the flora of the ancient world." These men were the pioneers of vegetable palæontology. It was reserved for Adolphe Brongniart to become its true founder. Brongniart's paper on the classification and distribution of fossil plants, which was published in the memoirs of the Paris Museum of Natural History in 1822, showed that he had already been some time at work, and after six years of nearly complete silence he at length came forward, in 1828, with his epoch-making works on the history of fossil plants—the "Prodrome" and the "Histoire des végétaux fossiles"—which, taken together as was the design, form the solid basis upon which the science has been erected.

Brongniart's fundamental conception was, that fossil plants were none the less plants, and that so fast as they really became known they should be placed in their proper position in the vegetable series and made to form an integral part of the science of botany. In his classification he therefore had due respect for the natural system as then understood, but he nevertheless felt that geognostic considerations must be taken into the account, and he saw with almost prophetic vision that in passing up through the geologic series higher and higher forms of vegetable life presented themselves. Although unable to understand the complete continuity in the series, as modern evolution postulates, and although affected by the Cuvierian idea of successive destructions and re-creations, still he insisted that each successive creation was superior to the one it had replaced, and that there had thus been, as it were, a steady progress from the lowest to the highest forms of vegetation. He divided the geologic series into

four great periods, the first extending through the Carboniferous and corresponding to the modern Palæozoic, the second embracing the Grès bigarré, or Buntersandstein, only, the third seeming to include the rest of the Trias, the Jurassic, and the Cretaceous, and the fourth completing the series. The table which he gives on page 219 of the "Prodrome" is designed to show the development of the higher types of vegetation in successively higher strata, and in discussing it he remarks that "in the first period there exist hardly anything but cryptogams, plants having a more simple structure than that of the following classes. In the second period the number of the two following classes becomes proportionately greater. During the third period it is the gymnosperms which specially predominate. This class of plants may be considered *intermediate between the cryptogams and the true phanerogams* [dicotyledons] which preponderate during the fourth period." The words italicized in the liberal translation here made are scarcely less than a prophecy, and one whose fulfillment is only now being tardily granted by systematic botanists.

As the result of his prolonged studies, Brongniart finally arrived at the following remarkable classification of plants, as drawn up on page 11 of the "Prodrome" and repeated on page 20 of the "Histoire:"

I. Agams.
II. Cellular cryptogams.
III. Vascular cryptogams.
IV. Gymnospermous phanerogams.
V. Monocotyledonous angiospermous phanerogams.
VI. Dicotyledonous angiospermous phanerogams.

In the present state of botanical science Brongniart's "agams" would probably all be relegated to his second group, or cellular cryptogams, but in other respects this classification is preëminently sound, and seems likely to be vindicated by the future progress of science.

It will thus be seen that Brongniart founded the science of vegetable palæontology firmly upon the law of progressive development, and there can be little doubt that if his influence could have been felt by botanists as it was by vegetable palæontologists in general, botany might have advanced *pari passu* with zoölogy. But Brongniart was far in advance of his time, and his views were destined to meet with violent opposition. His method was, with

few exceptions, adopted by subsequent palæo-botanists but never by botanists proper.

The most powerful antagonism to this effort of Brongniart to confirm Lamarckian principles from the phytologic side thirty-one years before the appearance of Darwin's "Origin of Species" was offered by the eminent English botanist, Dr. John Lindley, who found a fitting occasion to meet the great French palæontologist on his own ground while engaged with William Hutton in the preparation of their "Fosssil Flora of Great Britain," 1831–'37. Of this truly great work we are here concerned only with certain discussions which were directed against the then infant doctrine of biologic evolution in the vegetable kingdom, and which were not only marked with great acrimony, but were allowed to influence and to warp the classification adopted by the authors into forms which even to botanists now appear ridiculous. The introductory remarks in the first volume, as well as much of the general discussion throughout the work, are characterized by a most astonishing and apparently willful ignorance of the true principles of palæo-phytology as they were set forth by Brongniart, Sternberg and even Schlotheim, and which are now universally accepted.

One of Dr. Lindley's remarkable aberrations was the pertinacity with which he contended for the existence of cactaceous and euphorbiaceous plants in the coal measures. It is true that Parkinson had seen a fancied resemblance between certain stems and those of large cacti, and similar guesses had been made by Volkmann, Walch and other authors of the eighteenth century, when it was supposed that the counterpart of every fossil plant must be found in the living flora, but all these imaginings had been long since laid aside only to be revived by the leading botanist of Europe.

The theory of a former tropical climate in England and on the continent of Europe was assailed, the existence of tree-ferns in the Carboniferous was denied, the relation of the Calamitæ to the Equisetaceæ questioned, and many other tolerably well established generalizations were remanded to the domain of doubt and discussion.

The true secret of this sweeping skepticism is, however, not far to seek. It is found in the more general denial, which was finally made, of the conclusion to which the acceptance of these

rejected theories would naturally lead and had actually led M. Brongniart and others. The authors say: "Of a still more questionable character is the theory of *progressive development*, as applied to the state of vegetation in successive ages. In the vegetable kingdom it cannot be conceded that any satisfactory evidence has yet been produced upon the subject; on the contrary, the few data that exist appear to prove exactly the contrary." All the denials and assertions made in the work opposed to Brongniart's teachings are made to support this view. The existence of Cactaceæ, Euphorbiaceæ and other dicotyledons in the Carboniferous would negative development; the admission of a former tropical climate was a strong argument for the nebular hypothesis as well as for geologic progress; tree-ferns would argue such a former tropical climate; if Calamites could be shown to be a Juncus, a higher type would be found in Palæozoic strata than Brongniart believed to occur. Still another good point was thought to be gained by proving what is now admitted, viz., that coniferous plants occur in the coal. All botanists then held, as many still hold, that the gymnosperms were a subclass of the dicotyledons, coördinate with the dicotyledonous angiosperms But, curiously enough, Brongniart had forestalled this argument by making the gymnosperms of lower type, intermediate between the cryptogams and the angiospermous phanerogams. By a special insight, characteristic of true scientific genius, he had used their lower geological position as a proof of their lower organization, *i. e.*, had postulated evolution as an aid to organic research—a method which is now becoming quite common, although unsafe except in the hands of a master.

Dr. Lindley laid much stress upon the fact "that no trace of any glumaceous plant has been met with even in the latest Tertiary rocks," thus freely employing the fallacy which he elsewhere warns others to avoid, that because a class of plants has not been found, therefore it did not exist at a given geologic epoch. But to cut off the possibility of a reply to the position he takes he finally declares that "supposing that sigillarias and stigmarias could really be shown to be cryptogamic plants, and that it could be absolutely demonstrated that neither Coniferæ nor any other dicotyledonous plants existed in the first geological age of land plants, still the theory of progressive development would be untenable, because it would be necessary to show that

monocotyledons are inferior in dignity, or, to use a more intelligible expression, are less perfectly formed than dicotyledons. So far is this from being the case that if exact equality of the two classes were not admitted, it would be a question whether monocotyledons are not the more highly organized of the two; whether palms are not of greater dignity than oaks, and Cerealia than nettles." Teleologic and anthropocentric reasoning like this pervades all the discussions in this work and vitiates the scientific deductions. The elaborate experiment that Dr. Lindley made and described in the first dozen pages of the third volume, was obviously animated by the same spirit of uncompromising hostility to the development hypothesis. By showing that the higher types of plants when long immersed in water are earlier decomposed than ferns, conifers and palms, he thought he had demonstrated that the reason why we find no dicotyledons in the Carboniferous is simply because they had not resisted, and from their nature could not resist the destructive agencies to be overcome in the process of petrifaction. One could wish that he might behold the four thousand species of fossil dicotyledons now known, and realize how vain had been his experiment as well as all his theorizing!

It is such resistance as this, coupled with the power of the Jussiæan method, that has retarded the progress of correct ideas respecting the development of plant life. Systems of classification have been chiefly modeled after those of the early founders. The text books of botany still generally invert the order and begin with the phænogams, although this is doubtless merely intended to facilitate study, and does not at all imply that our leading botanists believe this to have been the order in which plants have developed. This inversion of the order, however, shows how completely the notion of development is ignored in modern botany, and the system throughout rests upon the evidence furnished by the organs of the plants as they are understood. Nevertheless, it is proper to say that at the present time quite a large body of the most thorough students of vegetal embryology and histology, chiefly in Germany, have rejected much of the modern system of botanical classification, and especially that which concerns the position of the gymnosperms. They prove in the most satisfactory manner that these plants constitute a lower type than any of the remaining phanerogams, and they

also find that in their reproductive organs they form a more or less natural transition from the cryptogams to the phænogams, between which they place them. This result is most gratifying to the palæo-botanist, for nearly all works on fossil plants give the gymnosperms this position at the base of the phænogamic series, so sagaciously assigned to them by Brongniart. They have been compelled to do this in the face of the prevailing botanical systems, because this is the position which they are found to occupy in the ascending strata of the earth's crust. It is astonishing that botanists could have remained so indifferent to such a weighty fact, and it is certainly most instructive to find the geological record, so long unheeded, confirmed at last by the facts revealed in living plants. There is no evidence that those who have thus confirmed it were in the least influenced by it, since Sachs and Caruel are as silent respecting palæontology as De Candolle or Bentham.

The founders and perfecters of the prevailing system of botanical classification have not been influenced to any marked degree by the idea of development in vegetable life. Few of the earlier ones had ever heard of development, except at least as a visionary theory. This system had become established long before the doctrine of the fixity of species had received a shock, for although Lamarck, himself a botanist, had sown the seed of its ultimate overthrow, still it required half a century for this seed to germinate, and it was during this half century that the Jussiæan system was supplanting the Linnæan and gaining a firm foothold.

Shaking off, for the time being, all fixed allegiance to any system, let us glance for a moment at the lesson which vegetable palæontology now teaches upon the subject of development.

(To be continued.)

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ON THE VERTICAL RANGE OF CERTAIN FOSSIL SPECIES IN PENNSYLVANIA AND NEW YORK.

BY PROFESSOR E. W. CLAYPOLE.

THE Second Geological Survey of Pennsylvania has recently published a report on Montour, Columbia and several other counties, written by Professor I. C. White, of the University of West Virginia. While engaged in the work Professor White requested the writer to determine for him the fossils which he

collected. This was done, and the results were embodied in the volume in question, G_7 of the Pennsylvania reports.

In the preface to the volume Professor James Hall, of Albany, has, through the State geologist, honored the palæontological portion of the work with certain criticisms which call for a few remarks. The science of palæontology advances so rapidly that statements which were perfectly correct at one time often cease to be so, and from this ground, if from no other, the criticisms contained in the preface of Professor White's report require some notice.

I.

It will not be necessary at any length to discuss Professor Hall's first remark concerning the dividing plane between the Chemung and the Catskill. In the present state of our knowledge this must be largely a matter of opinion. One observation will suffice. Whatever may be the fact in Montour and Columbia counties, there is no doubt that in Perry county, with which the writer is better acquainted, spirifers, unbroken and with both valves in contact, are found about 1000 feet above red sandstone beds holding the scales of Holoptychius or Bothriolepis or both.

II.

In regard to the spirifers of the Chemung, certain statements are made which are not in harmony with facts which the writer has observed in Middle Pennsylvania. For instance, on page xx we read:

"How is it possible to credit such a topsy-turvy appearance of the three species of Spirifera which, outside of Pennsylvania, have been found (1) never in any but Chemung rocks; (2) confined each to its own horizon; and (3) always in a fixed order from above downward, thus:

Spirifera disjuncta horizon (*S. dj.*).
Spirifera mesocostalis horizon (*S. mc.*).
Spirifera mesostrialis horizon (*S. ms.*)."

On page xxi we read further:

"*Spirifera disjuncta* and *Spirifera mesostrialis* form an impossible ? conjunction."

This assertion must be, to say the least, somewhat hazardous even with the interrogative point.

Again, on the same page:

"Professor Hall has never seen any two of the three species

coëxisting in the same stratum or at the same horizon or outside the limits of the typical Chemung. He would not be surprised if *S. mesocostalis* were found to ascend high enough above its proper horizon to mingle with *S. disjuncta*. But he cannot comprehend how *S. disjuncta* and *S. mesostrialis* should be found together."

In regard to this point the experience of the writer in Pennsylvania has led him to very different conclusions. So far from being strictly limited to single horizons, these three species appear to range with great latitude over each other's territory. This is especially true of the two lower fossils, *S. mesocostalis* and *S. mesostrialis*. It is no doubt true that each species is specially abundant in certain beds or zones, but while in a measure characterizing these, it spreads both above and below them, and mixes with one or both of the others.

These statements are made concerning Middle Pennsylvania and have no reference to any other district. The writer's experience among the rocks and fossils of New York is not sufficient to enable him to speak with any authority concerning them, and to these it may be supposed Professor Hall is chiefly referring in the passage quoted above.

Since the publication, however, of the report of Professor White, and called forth by its preface, a letter has appeared from the pen of Professor H. S. Williams, of Cornell University, in which, referring to these remarks of Professor Hall, he says:

"While the statement cited may express the general rule as to the occurrence of the species in New York State, there are specimens in Cornell University museum which do not bear out the statement.

"In the first place the two species, *S. mesostrialis* and *S. mesocostalis*, are found associated in the same stratum at Ithaca, N. Y., both in the *mesostrialis* zone and in the *mesocostalis* zone. Several instances can be shown where they occur on the same slab.

"From a higher horizon in New York State, and from several localities, either of these species may be found associated with *S. disjuncta*, and I have obtained each of the three species from the original Chemung locality at Chemung narrows.

"In the museum collection is a small slab containing beautiful representatives of *S. disjuncta* and *S. mesostrialis;* the latter preserving 'the fine radiate striæ with delicate concentric crosslines' all over the surface of the shell, and with 'the broad median fold without a depression' which are described as distinctive characters of the species (Pal. N. Y., Vol. IV, p. 243).

"The other specimen, only a couple of inches distant, has the characteristic plications on the medial fold, and with the surface equally well preserved, shows not the least trace of radiate or concentric striæ, unmistakably indicating *S. disjuncta.*

"From the same locality, though not on this individual slab, are specimens of both varieties of the so-called *S. mesocostalis*—the large coarse form with angular plications and reduplicated fold, and the more finely plicated form with prolonged hinge line which is more characteristic of a lower horizon."

From these statements of Professor Williams we find that the three following inferences are now known to be true for *New York State :*

1. That *S. mesocostalis* occurs associated with *S. mesostrialis.*
2. That *S. mesocostalis* occurs associated with *S. disjuncta.*
3. That *S. mesostrialis* occurs associated with *S. disjuncta.*

These are all the possible combinations of three things taken two together. Consequently these three species are mingled in New York State in all possible ways in which two of them can be combined.

In order to strengthen, if possible, by cumulative evidence the argument founded on these clear and definite statements, the writer applied to Professor R. P. Whitfield, of New York, asking if the collection of the New York Museum of Science, of which he is curator, could supply any facts that would support the views on the range of these fossils which are here maintained. The greater part of that collection was made and the specimens named by Professor Hall, so that no doubt regarding the identification of the species can be entertained. Professor Whitfield has stated in reply :

1. "On a small block of sandstone containing the specimen of *S. mesocostalis*, figured in the Palæontology of New York (Vol. IV, Pl. XL, Fig. 6), there is an imprint of a part of a very characteristic specimen of *S. disjuncta.*

2. "Another specimen measuring four inches by three, from Schoharie county, N. Y., and bearing Professor Hall's ticket (No. 302), contains one of the specimens of *S. mesostrialis*, figured in the same plate (Pl. XL), and also casts or imprints of three individuals of *S. mesocostalis.*

3. "Another small slab marked, in Professor Hall's writing, 'Tioga county, N. Y.,' contains two dorsal valves of *S. disjuncta* and two ventrals of *S. mesocostalis.*

4. "Another small block, bearing Professor Hall's ticket, shows dorsal valves of *S. mesocostalis* with specimens of the long mucronate hinged form of *S. disjuncta.*

5. "One from Vandermark's creek with large examples of *S. disjuncta* contains a ventral valve of *S. mesocostalis.*

6. "Another bearing Professor Hall's ticket (279), from Cayuta creek, N. Y., has *S. disjuncta* with *S. mesocostalis.*"

Professor Whitfield also adds :

"On one small specimen weighing ten or twelve ounces and bearing the label 'Cayuta creek,' with characteristic specimens of *S. mesocostalis* and *S. disjuncta*, there is an imperfect imprint of the medio-dorsal part of a ventral valve presenting the features of *S. mesostrialis* as it occurs at some western localities [of N. Y.], but its outline is too imperfect to admit of positive identification."

The testimony obtained from the collection in New York, therefore, agrees in every point with that given in Professor William's letter, and suggests in addition the possible association of all the three species at Cayuta creek.

Yet one fact more may be given. Professor H. W. Geiger, of the U. S. Geological Survey, has informed the writer that he possesses a slab from the Chemung of Virginia on which *S. mesostrialis* and *S. disjuncta* are lying side by side.

In the face of these facts it is quite impossible any longer to maintain the sharp delimitation of the horizon of these three species above and below. It is evident that though characterizing, probably in some places by their abundance, certain zones, they are not by any means limited to these zones, but invade each other's territory to an undefined extent.

This result is more in harmony than its opposite with our present views of the progress of life on the globe. We have no reason to believe that species came suddenly into ascendancy and then as suddenly went out, especially at times unmarked by any catastrophe, as was the case in the Chemung era in Middle Pennsylvania and New York. On the contrary, the general belief in evolution involves the special belief that every species has, in ordinary circumstances and barring accident, had its time of rising, culmination and decline, during which its life has overlapped the life of other kindred and perhaps derived species. Nothing is less likely, *a priori*, than that three species of spirifer should lie like three drawers in a geological cabinet one above another. Nothing is more likely than that each should occur in gradually increasing numbers until it reached its maximum, and then in gradually diminishing numbers until it died away. Each may then

distinguish certain horizons, as Professor Hall describes them, but without sharp and decisive limitation to these horizons.

It is farther possible, and not improbable, that these zones of maximum abundance hold the same relative positions to one another in New York and in Pennsylvania. This, however, must be decided by closer study. Nothing that the writer has seen or published is antagonistic to such belief. But even if the zones of maximum abundance should not hold the same relative positions to one another in different parts of the country, we are not driven to the alternative of asserting a "subversion of specific types in vertical range" (p. xxvi). Given the three species, or indeed any two of them, living side by side through the greater part of the Chemung era, and we need only admit that local conditions favored here the one and there the other, and the whole difficulty disappears. It is purely imaginary. It is scarcely probable that identical conditions of life existed contemporaneously over so great an area, it need not consequently shake our belief in palæontology if the result should show that in Pennsylvania and Virginia, or in States still more distant, the zones of maximum abundance hold an order different from that which Professor Hall has laid down for New York.

Another fact may be mentioned in this connection which, though not directly connected with the argument, yet serves to show that the lines of delimitation bounding the range of fossil species cannot be laid down as definitely as has been done by some palæontologists. *S. lævis* is one of the characteristic fossils of the Portage group in New York State occurring neither above nor below, so far as the writer is aware. Yet in Middle Pennsylvania it has not been found in the strata occupying the position of the Portage of New York, and holding other Portage fossils. But it does occur higher up, in the Chemung proper, and in company with *S. mesocostalis*.[1] *S. lævis*, it may be added, is a well characterized species in New York, and is therefore readily recognized.

III.

Passing on to another topic, we find on page xxii:

"*Orthis tulliensis* has certainly never been seen before in the Chemung two hundred feet above the Genessee (*i. e.*, three hundred feet above the Tully limestone), nor in the company of *S. mesocostalis*."

[1] This is possibly *S. mesostrialis*. The specimen is only a fragment.

This statement may be strictly true, but it may be urged, on the other side, that there is no distinct character by which *O. tulliensis* can be separated from *O. impressa.* No doubt two forms can be picked out as types of the so-called species, but their variation is considerable and they run into one another. It would be exceedingly difficult, perhaps quite impossible, to separate accurately a mixture of the two species if the horizons of the specimens were unknown. We seem here to have an example of a vicious reasoning of which palæontology affords not a few similar instances. The Orthis from the Tully limestone is called *O. tulliensis;* that from the overlying Chemung is called *O. impressa.* But barring this difference it would be hard to draw a line between them. The practice of giving different names to fossils simply because they come from different horizons has been carried too far. It has created artificial barriers in the way of tracing the evolution of species and the connection of strata. Neither geological nor geographical separation is sufficient reason for distinguishing by name fossils between which no clear structural difference can be pointed out. The cases are few, especially among the Testacea, that justify resort to the argument used by the late Professor Meek, "that if the whole structure of the animal had been preserved doubtless some distinctions would be found which do not exist in the fossil."

Referring to the extract given above from the preface of G_7, Professor Williams says in the letter already quoted:

"In regard to *Orthis tulliensis* it may be said that the common Orthis occurring at the base of the Ithaca fauna within a few hundred feet above the Genessee shale (less than 500) resembles at its first appearance *Orthis tulliensis* in form and general character, though for distinctness it may be appropriate to call it a variety of *Orthis impressa*, since a little higher and in the same fauna the typical *Orthis impressa* appears in abundance.

"Still there are specimens in the collection, from the lowest zone, which it would be difficult for any one to distinguish by microscopic or macroscopic characters from *O. tulliensis.*"

There is therefore *in New York* an Orthis which cannot be distinguished from *O. tulliensis*, occurring not at 200 feet only, but at a yet greater height (less than 500 feet) above the Genessee shale.

In regard to the association of this fossil with *S. mesocostalis*, Professor Williams adds:

"I have no single slab containing this form with *S. mesocostalis*,

but the latter is found both above and below the stratum containing the Orthis."

IV.

Reverting to the preface of G_7, we read on page xxii this remark, apparently by the State geologist:

"*Halysites catenulatus* [the common chain-coral] is found quite out of its natural place; at one locality only it is true, but in such abundance as to make up a large proportion of the twenty feet of beds through which it is found."

"'Sir W. E. Logan recognizes it as low as the *Trenton limestone*, and I have seen a form or variety of the same in the *Hudson River group* of Green bay,[1] but no one has ever before found it above the Niagara.'"[2]

Professor Lesley adds very justly:

"Whatever may be the difficulty of distinguishing *S. disjuncta* from *S. mesostrialis*, it is quite impossible for any one to mistake *Halysites catenulatus*, the characteristic form of the *Niagara limestone* all over the United States and Canada, and also of the corresponding *Wenlock* of Europe.

In these passages there are obvious traces of the vicious reasoning already condemned. The "natural" place of a fossil is surely that in which it is found. Its "canonical" place may be very different. Now of the occurrence of *Halysites catenulatus* in the Lower Helderberg limestone at the place mentioned by Professor White, there cannot be the slightest doubt. The obvious character of the fossil, such that every tyro in palæontology is acquainted with it, precludes all chance of mistake in its identification. The position of the limestone bed in which it was found is equally decisive against stratigraphical error. It overlies several hundred feet of red shale and sandstone, which are the equivalent of the Onondaga shales of New York—the Salina shale or Salt group, as they are often called.

The correlation of these has been satisfactorily determined in Middle Pennsylvania, and the evidence, both stratigraphical and palæontological, may be seen in the writer's report on Perry county (F_2). It is proper to add here that the above statement concerning the place of the bed is made from personal knowledge, the ground having been visited for the purpose in company with Professor White.

[1] Some inconsistency exists between this statement and that on p. xxv. "Professor Hall has given himself infinite trouble to obtain the data on which rests the proof that *H. catenulatus never* occurs except in *Niagara* and *Clinton* rocks."

[2] Letter from Professor Hall.

Immediately above the limestone bed in question comes the Oriskany sandstone, so that the evidence for position is rendered doubly sure, and it would be idle, in the face of all the facts, to entertain any remaining doubt or suspicion regarding the horizon or the species of the fossil. It is *Halysites catenulatus*, and it is found in the Lower Helderberg limestone.

Halysites catenulatus ranges in England from the Llandeilo up to the Wenlock, and in America from the Trenton to the Niagara, by consent of all geologists. At this horizon its disappearance has been assumed. But the determination here maintained carries it up through about 1200 feet of strata, and extends its specific life through a correlative lapse of time.

In the consideration of these facts it may be remarked that the very ease and certainty with which this fossil can be recognized appear to the writer a possible source of error. Being abundant at numerous places in the Niagara limestone, it forms a convenient fossil reference, and its range has been, by tacit consent and perhaps with the aid of influential names, assumed to be limited upward by the summit of the Niagara. It has thence become the practice to refer all strata containing it to the Niagara group, and the two have become closely associated. Yet the foundation for so strict a delimitation is as unsatisfactory as in the cases previously examined. It is in fact another instance of vicious reasoning. *Halysites catenulatus* occurs very frequently in Niagara rocks, therefore all rocks yielding *Halysites catenulatus* are of Niagara age.

If this fallacy be avoided and the upward range of Halysites be admitted, its occurrence in the place and on the horizon mentioned by Professor White (in G_7) instead of being "a serious matter for Pennsylvanian geology" (p. xxiii), may be a matter of importance to the geology of some States outside of Pennsylvania, and may even cause the removal to a higher level of some strata which have been hitherto placed in the Niagara group by the hasty deduction above condemned.

For example, it is just possible, to say no more, that the occurrence of this fossil in the cement beds, as at Kingston, N. Y., may be hereby explained. If these cement beds are the same as those usually included under that name, they should lie in the Lower Helderberg series and not in the Niagara, as often stated. Moreover a reference to Professor Hall's geological map of New

York State (Geol. N. Y., Vol. IV, 1843), and also to that of the Geological Survey of Canada, 1863, will show that no outcrop of the Niagara is represented within a hundred miles of Kingston, the color representing that group ceasing near Utica, while the Lower Helderberg continues and underlies the town. It is hard to resist the conclusion that we have here an instance of correct stratigraphy overruled by incorrect palæontology, and that so far from its occurring only in the Niagara this is an example in *New York State* itself of the occurrence of Halysites in the Lower Helderberg limestone.[1]

V.

From the facts and arguments here set forth the general conclusion must follow that all attempts to confine the range of species within certain arbitrary lines are attempts that are not likely to succeed. The geological record as written in the rocks is a record of life. Evolution teaches us that life advanced by slow stages from species to species; that as one died out another took its place. Evolution knows nothing of breaks or of hard and fast planes of limitation in the range of species. All such planes are indications of imperfection in the geological record, perhaps evidence of catastrophes on a small scale, but they are no proof of widespread disaster and destruction. And in proportion to the advance of our knowledge we must expect, on the principles of evolution, to see these breaks one by one disappear, and these lines be one after another effaced until the record of the rocks is in harmony with the record of life which it represents. That this harmony will ever be perfect is unlikely, for the rocks will never give up all their dead, but that it will one day be much more nearly complete than now is axiomatic, in the face of the continual discovery of missing chapters in the history supplying missing links in the chain of life.

The artificial systems of palæontology which have been constructed by the faithful, earnest and devoted labors of the students of the science are but temporary. They are invaluable aids to the progress of the work, but they are only the means and not

[1] On p. xxiii (G_7) an error appears which causes some confusion. "*S. macropleura* is the earliest spirifer which shows ribs in the medial series (sinus ?), and it recurs nearly unchanged in the Subcarboniferous Chester limestone of the West." *S. macropleura*, as may be seen by looking at Professor Hall's figures (Pal. N. Y., Vol. III, Pl. 27), has no ribs in the medial sinus. Nor does it recur nearly unchanged in the Chester limestone of the West.

the end. Progress will be hindered if these systems are allowed to cramp and fetter us. If preconceived notions of what *should be* are suffered to blind our eyes to what really *is*, our palæontology would itself become a fossil, as dead as the trilobites of palæozoic days. Our subdivision of the geological column into Hamilton, Chemung, Catskill, &c., or even into Cambrian, Silurian and Devonian, &c., is simply a device to assist memory and classification, not to represent actual and separate creations. And with every new discovery we must expect to see the lines and planes that separate these imaginary groups and systems become less and less clear until they are fused into a whole whose parts shade into one another like the colors of the rainbow. Nature is larger than our systems, and our knowledge of fossil nature must some day outgrow our artificial "canons of palæontology." But in all such cases nature cannot be warped to our "canons," our "canons" on the contrary must bend to the facts of nature.

The writer cannot conclude without, superfluous as it may seem, adding a word to express his sense of the value of the labors of Professor James Hall in American palæontology. He has laid broad and deep foundations for future workers. How numerous or industrious soever they may be, they must always acknowledge that they are building over his beginnings. That some errors should creep into work so great and varied is to be expected. But compared with the grand whole, they are insignificant. In pointing out and correcting a few of these errors in the foregoing pages, nothing is farther from the writer's wish than to seem to depreciate Professor Hall's labors. The facts and misstatements here criticised are mainly details—mere spots on the face of the sun—but for that reason the more worthy of attention and scrutiny.

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ANCIENT ROCK INSCRIPTIONS ON THE LAKE OF THE WOODS.

BY A. C. LAWSON, M.A.

WHILE prosecuting a geological survey of the Lake of the Woods last summer, I observed upon the rocks, at two places not far distant from each other on the shores of the lake, ancient inscriptions which may be of some interest to those who are engaged in gathering up and weaving together the scattered

threads of evidence, which in the web display the checkered life-history of the aboriginal peoples of the American continent. I am induced to publish this note on the subject at present, rather than wait for further opportunities of collecting additional material, because of the striking resemblance which some of the characters of these inscriptions bear to those of certain Brazilian rock inscriptions figured by Mr. John C. Branner in his interesting paper in the December number of the AMERICAN NATURALIST.

The Lake of the Woods is divided about its middle into two parts, a northern and a southern, by a large peninsula extending from the neck of land at Turtle Portage on the east side of the lake to within a very few miles of the west shore. On the north side of this peninsula, *i. e.*, on the south shore of the northern half of the lake, about mid-way between the east and west shores, occurs one of the two sets of hieroglyphic markings to which I refer. The more typical examples of these are figured in Plate XIX. Lying off shore at a distance of a quarter to half a mile, and making with it a long sheltered channel, is a chain of islands trending east-and-west. On the south side of one of these islands, less than a mile to the west of the first locality, is to be seen the other set of inscriptions. The first set occurs on the top of a low, glaciated, projecting point of rock which presents the characters of an ordinary *roche moutonnée*. The rock is a very soft, foliated, green, chloritic schist into which the characters are more or less deeply carved. The top of the rounded point is only a few feet above the high water mark of the lake, whose waters rise and fall in different seasons through a range of ten feet. The antiquity of the inscriptions is at once forced upon the observer upon a careful comparison of their weathering with that of the glacial grooves and striæ, which are very distinctly seen upon the same rock surface. Both the ice grooves and carved inscriptions are, so far as the eye can judge, identical in extent of weathering, though there was doubtless a considerable lapse of time between the disappearance of the glaciers and the date of the carving. The ice grooves are not merely local scratches but part of the regular striation which characterizes the whole region. Both the striæ and inscriptions present a marked contrast to some recent letters which passing traders or travelers, attracted by the novelty of the inscriptions, have cut into the rock, much in the same spirit as that in which my Christianized Indian canoe-man pro-

ceeded to carve his initials in the rock with my hammer the moment we landed. The weathered and rough character of the carving afforded no clue as to the tool used. In size the characters varied from about three to twelve inches. There was no indication of ochre having been rubbed into the carving. The characters figured in Plate XIX were scattered over the rock surface in all directions and in greater numbers than are represented; and although the typical ones are gathered together on one sheet, that arrangement by no means shows their relative positions. The chief advantage to be derived by archæologists from an acquaintance with such inscriptions is the tracing out the similarity or identity of the individual characters with those of inscriptions found in other parts of the continent. There is little hope of any coherent meaning or narrative ever being derived from such isolated groups of characters.

The similarity of some of the characters now figured to those described by Mr. Branner from the boulders of Alagôas is a striking and suggestive one. For example, No. 2, Plate XIX, is identical with the left-hand figure of Mr. Branner's *h*, even as to the number of whorls and their direction. No. 25 is almost identical with *a* and *b* of Mr. Branner's plate. The horse-shoe or part-circle shape is distinctly common to both, as may be seen by comparing *X* and *d* of the Brazilian inscriptions with 17, 18, 21, 23, 24 and perhaps 29 of those from the Lake of the Woods. Nos. 7, 8, 15, 20 may be compared with Mr. Branner's asterisk as simpler forms on the same principle. The circle is also common to both sets. Nos. 1, 4, and 14 are similar in character to the 3d form from the top of Mr. Banner's *X*. No. 10 has nearly the same shape as the 3d on the top row of the same group. No. 12 is not unlike Mr. Branner's *c* and No. 19 is on the same principle as the chain of small circles of his *f*. But there is no need of straining the comparison. The coincidence appears to be too strong to be purely accidental, although considering the remoteness of the two regions in question, much more abundant material for comparison would be required before inferences, even of the most general sort, could be drawn.

The island on which were found the other inscriptions to which I have alluded, is one of the many steep rocky islands known among the Indians as *Ka-ka-ki-wa-bic min-nis*, or Crow-rock island. The rock is a hard greenstone, not easily cut, and the

Indian Inscriptions, Lake of the Woods.

inscriptions (Fig. 1) are not cut into the rock but are painted with ochre, which is much faded in places. The surface upon which the characters are inscribed forms an overhanging wall protected from the rain, part of which has fallen down, cutting off the inscription sharply at 6. The characters are represented in their relative positions as they appear on the rock surface,

FIG. 1.—Indian Inscriptions.

reduced about ten times. Two of the forms, viz., 1 and 4, have a sufficiently strong resemblance to 16 and 9 respectively of Plate XIX, although one is in ochre and the other carved into the rock, to lead to the belief that the two inscriptions are closely related in authorship. The Indians of the present day have no traditions about these inscriptions beyond the supposition that they must have been made by the "old people" long ago.

KITCHEN GARDEN ESCULENTS OF AMERICAN ORIGIN. III.

BY E. LEWIS STURTEVANT, M.D.

(Continued from p. 553, June number.)

Pumpkins and Squashes. — In New England's Annoyances, Anon., 1630, the first recorded poem written in America, we find:

> "If fresh meat be wanting to fill up our dish
> We have carrots and pumpkins and turnips and fish.

Again:

> "Our pumpkins and parsnips are common supplies:
> We have pumpkins at morning and pumpkins at noon:
> If it was not for pumpkins we should be undone."

And:

> "For we can make liquor to sweeten our lips
> Of pumpkins and parsnips and walnut tree chips."

And the pumpkin has ever been considered a favorite vegetable for the making of pies in New England, and the various squashes form an appreciated vegetable.

Pumpkins and squashes seem to be of American origin, although De Candolle[1] says "it may be confidently asserted that the pumpkins cultivated by the Romans and in the middle ages were *Cucurbita maxima*, and those of the natives of North America, seen by different travelers in the 17th century, were *C. pepo*. There are no figures of the pumpkin in the Herbarius Bataviæ Impressus of 1485, before the discovery of America, yet it is frequently figured by botanists of the 16th century." Anton Pinæus[2] figures the bottle gourd, or Lagenaria, under the name of *haraha* or *hara* or *charha* of the Arabs, *zucca* of the Italians, *kurbss* of the Germans, *calabassa* of the Spaniards, *courge*, *courle* or *causse* of the French. His figure of the pumpkin is called *Cucurbitæ indiane* and *peregrinæ*, *zucche Indiane* of the Italians, *courges d'yuer* of the French, which indicates how the old world names were applied to new world resembling productions, with the origin prefix which soon became dropped.

One of the confusing elements in the research into the history of plants is the absurd use of common names, and often the inapplicability of the term used to express resemblance if interpreted in other than the most general sense. Thus Ludovico de

[1] Origin of Cult. Pl., 256.
[2] Hist. Plant., 1561.

Varthema, 1503–8, mentions a fruit called *camolango* in India, which is unquestionably *Benincasa cerifera* Savi, as "resembling a pumpkin."[1] Now as a matter of fact this cucurbit, as grown at the New York Agricultural Experiment Station, resembled a watermelon so perfectly that it was plugged by thieving boys, and until its waxy coating was acquired, could deceive visitors who did not notice the leaf. Early voyagers to America, as Gray states:[2] "Wrote *cucurbita*. *calabaza*, *courge* or *zucca* as a name for any gourd or pumpkin, and occasionally for a calabash which was not even a cucurbit;" and translators have been equally as indefinite in their interpretation of the original word used by their authors. It seems useless, therefore, to add the testimony of travelers of the sixteenth century, and which are not quoted by De Candolle[3] and by Gray and Trumbull,[4] for to those who would deny the accuracy of the vernacular names used, such transcripts would not be convincing. A most valuable argument, however, is the absence of certain identification of this class of plants with the names used by authors preceding the discovery of America,[5]

[1] Travels, Hak. Soc., v, 32.

[2] *Am. Jour. of Sc.*, May, 1883, 371.

[3] Geog. Bot. and Origine des Cult. Pl.

[4] *Am. Jour. of Sc.*, May, 1883.

[5] The Cucurbita of the ancients was either Cucurbita, or Lagenaria, or Benincasa of modern botanies, a proposition to which all investigators will agree. The authors which I have at hand are Columella, Pliny and Palladius, covering the first and third century of the Christian era. From their writings we can infer two propositions. First, it could be a Lagenaria; second, it could not be *Cucurbita maxima*.

Columella lays especial stress upon the "neck" (lib. x, v, 380–389); in verse 234 he uses "*fragili* cucurbita *collo*" as a distinguishing term; in verse 380 he uses the word *prægnans*, which finds explanation in verse 384. His directions for planting (lib. xi, C. 3) applies equally to pumpkins or gourds, but the stress laid upon the uses indicate a gourd, and a gourd only of our known plants; as a food plant he scarcely notices it. This small use of the Cucurbita of the ancients as a food, finds countenance from Apicius, who treats of them (lib. iii, C. 4) as a vegetable, but adds to the dish pepper, cumin, silphium, rue, fish sauce and vinegar in order to make them palatable. At the present time, according to Vilmorin, the Lagenaria is eaten, while young, in the manner of a squash, but is usually grown for ornament. These characters, as given by Columella, all apply to *Lagenaria vulgaris*, and not to *Cucurbita maxima*. Palladius (lib. iv, C. 9) describes the *neck* or *bottle form*, and the uses as utensils, and does not indicate their use as food. Pliny (lib. xix, C. 23) describes a fruit called *melopepo*, shaped like a quince and of recent introduction. His reference to color, *odor*, and their *dropping from the stalk when ripe*, would seem to indicate our melon. In lib. xix, C. 24, he speaks of the climbing habit of the Cucurbita of one kind, and the weight of the fruit so heavy that the wind does not move it, and yet attached to a small stalk; of variable shape, sometimes long like a ser-

and the frequent descriptions and mention by botanists and travelers after the discovery of America.

Naudin, the authority on this genus, refers all the forms of the cultivated pumpkins and squashes to four species, *Cucurbita maxima, C. pepo, C. moschata* and *C. melanosperma.* The three first forms of these are in French culture, and Vilmorin describes thirty-two varieties.[1] Of the eighteen varieties under *C. maxima*, eight have their American origin indicated by name or statement; of the five varieties under *C. moschata*, two have American names; of the nine varieties under *C. pepo*, three have an American origin indicated by name. The historical record does not seem to change this numeration in such a way as to indicate that *C. maxima* is more native to Europe than is *C. pepo.* We may, however, trace the appearance of such forms of this vegetable as we have data for, and we shall find that America has contributed very largely to the varieties.

The word *pumpkin* seems to have been transferred to our cucurbits from the Greek *pepon*, "a gourd or melon not eaten till quite ripe," Aristoteles,[2] or the Latin *pepo*, "a species of large melon or pumpkin, Pliny,[3] but the word does not occur in Scriptores Rei Rusticæ veteres Latini of Gesner, which indicates how little known was the *pepo* in Italy where now the pumpkin is so common, and where it so early appeared after the discovery of America. The word *squash* seems to have been derived from the

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pent, even, says our chronicler, occasionally nine feet long. He evidently refers next to the Benincasa, which he has confounded with the gourd, for he says it is covered with *a white bloom*, especially as it grows large. There is not a word here to indicate a pumpkin of any kind; the whole wording may apply to *Lagenaria vulgaris* in its varieties, except the last, which fit *Benincasa cerifera.* To one who will read Columella, Pliny and Palladius with Vilmorin's Les Plantes Potageres in hand, the references of our authors will be seen to apply very closely to the Lagenaria varieties figured therein; sufficiently so for a clear identification, taken with the context; and to apply *not at all* to any of the Cucurbita varieties therein figured and described under *Cucurbita maxima.*

While upon Latin authors we will take occasion to note that neither Columella nor Palladius reckon the *faseolus* or *phaseolus*, which some writers have taken to be kidney-beans, among garden plants, but class with field crops, and Virgil classes with the vetch as a cheap food. The directions for planting are to sow the seed, six pecks per acre, in the autumn. Hence their *faseolus* must have been a hardier plant than our kidney-bean, and *not* our bean. Apicius' receipt for cooking and Pliny's mention would apply equally well to a Dolichos as to a Phaseolus.

[1] Les Pl. Pot., 171–186.

[2] Liddell and Scott's Greek Dict.

[3] Andrews' Lat. Lex.

New England Indian "*Askutasquash*—their vine-apples—which the English, from them call squashes,"[1] or *isquotusquashes*,[2] or "*squashes*, but more truly *squoutersquashes*,"[3] or from the New York Indian *quaasiens*.[4] The first vernacular use of the word *cymling* used to designate a form of bush squash (also called *pattypan*, probably from its shape, the word *pattypan* signifying "a pan to bake a little pie in"),[5] that I find is in 1648, when *symnels* and *maycocks* are enumerated among other edible products of the region at the mouth of the Susquehanna.[6] In New England's Crisis, a poem by Benjamin Thomson, in 1675, we find:

> "When Cimnels were accounted noble blood,
> Among the tribes of common herbage food."

The word *cushaw* is Indian, and is derived from *ecushaw* of Heriot, 1586. It was applied to a bluish-green, white-streaked large pumpkin by Beverly,[7] and the description applies to the Puritan squash of Burr, and also to a Florida squash grown at the N. Y. Agr. Exp. Station, in 1884, from seeds obtained from the Seminoles in Florida. The word *cuckaw* is now used as a synonym of the winter crookneck of New England, and *cushaw* or *cashaw* to a Southern form of like character, both of which have two forms, one of which is the form of the *Puritan* and *Neapolitan* grown at Naples, the other crooknecked. It is interesting to note that *courge de la Floride* is a French synonym of the Neapolitan.[8]

The popular grouping of this class of vegetables does not conform to the scientific. Gregory[9] offers the definition in use: "Grouping all the running varieties together, we express the marketman's idea of a *squash*, as distinguished from a *pumpkin*, when we say that all varieties having soft or fleshy stems, either with or without a shell, and all varieties having a hard woody stem, and without a shell, are *squashes*. While all having a hard stem and a shell, the flesh of which is not bitter, are *pumpkins*: and all of this latter class the flesh of which contains a bitter

[1] Roger Williams' Key, &c., 222.
[2] Wood, New Eng. Prosp., Pt. 2, Chap. VI.
[3] Josselyn's Rar., 89.
[4] Van der Donck, Desc. of New Netherlands, 1656.
[5] Webster's Dict.
[6] A Desc. of New Albion [1648].
[7] Hist. of Va., 124.
[8] Vil., Les Pl. Potag.
[9] Squashes, p. 4.

principle, are *gourds*." An examination of a more complete set of varieties than the marketman uses, however, shows that this classification is not always correct. The popular use of the terms seem to be, *squashes* are those forms used on the table; *pumpkins* those forms that are grown for stock and for use in pie making; *gourds* are *Lagenaria vulgaris*, and have white flowers. It is thus seen that the popular word as used now would be as misleading as are the popular words used by the early explorers.

De Candolle is willing to grant that *C. pepo* is American, but is uncertain about *C. maxima*. He says, however, that seeds, certified by M. Naudin to belong to this species, have been found in the tombs of Ancon, a conclusive circumstance if the date of the latest burials at Ancon were certain. The Brazilians had, however, a name for this plant, *jurumu*,[1] and Pickering[2] quotes a Carib name, *jujuru* or *babora*,[3] but Schomburgh[4] gives *aboboras* as the Brazilian name of *C. pepo* L. It is the *Pepo maximus indicus compressus* of Sloane (1707), *Cucurbita pepo* Aubl. Sloane's name being the same as used by Lobel, 1581 (?).[5] In traditionary relations the large pumpkin appears in Mexico, for Bancroft[6] says: "In the golden age of Mexico, during the reign of Quetzalcoatl, pumpkins were said to measure a fathom round." Pickering[7] says that "melones" too large for a man to lift, some of them internally yellow, were noted by Oviedo[8] in the West Indies. The "mammoth" squash belongs to this section, and Loudon records a weight attained of 245 lbs., and a "mammoth chili" was exhibited in New York in 1884 by a seedsman, which weighed 223 lbs. In 1857 one weighing 264 lbs. was exhibited at the California State Fair, and one weighing 313 lbs. is said to have been shown at the Smithfield Club Cattle Show in Liverpool.[9] Messrs. Asa Gray and J. Hammond Trumbull[10] seem to have offered sufficient reason to believe that all the pumpkins and squashes are of American origin. I may only add therefore some horticultural evidence.

[1] Piso. Brazil, ed. 1658, 264; Marcq., ed. 1648, 44.
[2] Chron. Hist. of Pl., 709.
[3] Desc.
[4] Hist. of Bar., 593.
[5] De Candolle, Geog. Bot., 901.
[6] Native Races, III, 241.
[7] l. c.
[8] Nat. Hist., 80.
[9] Vick's Month., 1881, 51.
[10] *Am. Jour. of Sc.*, May, 1883,

In 1828 five varieties of "pumpkin," three of squash and two of summer squash were offered in our best seed catalogue, one of which was the Commodore Porter Valparaiso, brought from Chili by Com. Porter, and representing *C. maxima* in the list of *squashes*. In 1885, in one seed catalogue five varieties of *pumpkin*, twelve varieties of *squash* and four of summer squash; of these *squashes* seven belong to *C. maxima*, and the Valparaiso is not included. The Hubbard is said by Gregory, its introducer, to be of unknown origin, but to resemble a kind which was brought by a sea captain from the West Indies; it was distributed in 1857. The *marblehead* came from the West Indies, and was distributed about 1867;[1] the autumnal marrow or Ohio appeared in 1832; the Butman in 1875. Not one variety of this class seems to have originated in Europe, although *pumpkins* of this species are found there in numerous forms, but most of them in general characters of form of fruit can be duplicated from the varieties of traditionary origin in New England. Vernacular names count for little, but the *citrouille iroquois* applied to a French pumpkin of this species would add support to the traditionary belief that pumpkins of like nature formerly existed among the Northern Indians. Molina, 1787,[2] mentions "the yellow flowered or Indian gourd, called *penca;* it is of two kinds, the common and the mamillary This last in its leaves and flowers resembles the first, but the figure of the fruit is spheroidal, with a large nipple at the end; the pulp is sweet, and its taste is very similar to a kind of potato known by the name of camote," a description which will only apply to the varieties of the squash of the turban character.

It would seem as if the burden of proof was upon botanists to show the Asiatic origin, or a knowledge of the pumpkin and squash before the voyage of Columbus, before rejecting the American evidence as inconclusive.

Purslane. — Gray and Trumbull are inclined to believe that Purslane was in the new world at the time of the discovery. Oct. 28, 1492, Columbus saw "verdolagas" on the north shore of Cuba.[3] Oviedo, writing about 1526, enumerates among native plants of Hispaniola "verdolagas and pertulaca," and in 1525 mentions the abundance of "verdolagas." Jean de Lery in Bra-

[1] Gregory, Squashes, 1867.
[2] Hist. of Chili, 1, 93.
[3] Navarette, 1, 183.

zil, 1557, mentions "pourpier." Sagard-Theodat, speaking of the country of the Hurons, speaks of *pourpier* or *pourcelaine* being a common weed of their cornfields. These quotations are from Gray and Trumbull's article, *Am. Jour. of Sc.*, April, 1883.

Champlain, in 1605, speaking of the Indians of the Maine coast: "They brought also some purslane, which grows in large quantities among the Indian corn, and of which they make no more account than of weeds."[1] Josselyn, about 1672, speaks of it in Massachusetts,[2] and Cutler, 1785, mentions it in cornfields, and as eaten.

Hawkins, 1593, at Cape Blanco, So. America, found upon the rocks "great store of the hearbe purslane," which he collected for the refreshment of his sick.[3]

While it is not certain that these authorities all meant *Portulaca oleracea* in their mention, yet it would appear very strange if such a common weed of cultivated lands of the old world had not been well known and recognized.

Purslane, in one variety, yet finds sale among the seeds of our seedsmen among potage herbs.

Claytonia perfoliata Don. is called in France *Claytonia de cuba*, and pourpier d'hiver; in Spain *verdolago de cuba*.[4]

Sweet Corn.—All the forms of maize are of American origin. The early history of the sweet or garden form-species is very obscure, although the peculiar appearance and rich edible quality of its sweet kernel would presuppose quick and flattering recognition from the first comers.

Sweet corn is said by some to have been brought by Lieut. Richard Bagnoll from Gen. Sullivan's expedition against the Six Nations in 1779, and to have been called *papoon corn*. The anonymous writer in the New England *Farmer* (Sep. 7, 1822) under the pseudonym "Plymotheus," says: "That was the first of the species ever seen here, and since that time it has been more and more diffused; and I believe within a few years only, has been generally and extensively cultivated for culinary purposes." In another communication (Aug. 3, 1822) it is said to have been found during Sullivan's expedition "among the Indians on the border of the Susquehanna." Another account[5] says it was found by Sullivan's

[1] Voy. Prince Soc. ed., 75.
[2] Rar., 81.
[3] Hawkins' Voy., Hak, Soc, ed., 137.
[4] Vilmorin, Les Pl. Pot., 157.
[5] Loudon's Gard. Mag., VI, 483.

command in the Genesee country in 1779, and brought to Connecticut, whence it proceeded south.

Sweet corn is neither mentioned nor hinted at in Jefferson's Notes on Virginia, written in 1781. Timothy Dwight applied the synonym "shriveled corn," usually called "sweet corn," and says that "maize of the kind called sweet corn was the most delicious vegetable while in the milky stage of any known in this country. At New Haven the sweet corn may be had in full perfection for the table by successive plantings from the middle of July to the middle of November.[1] Dwight traveled in New York and in New England in 1817 and before, and was in Yale College in 1795. (This quotation was contributed to me by O. P. Hubbard, New York.) Bordley[2] says: "It has appeared to me that the sort called *sweet corn* (having a white shriveled grain when ripe) yields stalks of richer juice than the common corn."

Sweet corn is first mentioned for sale, so far as we have seen, in Thorburn's seed catalogue of 1828, one kind only, the *sugar* or *sweet* being named. It is not spoken of by name even in his Gardeners' Kalendar for 1817 or 1821, nor in M'Mahon's American Gardeners' Calendar, 1806, nor by Gardiner and Hepburn, 1818, nor in a Treatise on Gardening,[3] 1818, nor in Fessenden's New American Gardener, 1828. In 1829 several ears of a "new variety" from Portland, Me., were exhibited before the Massachusetts Horticultural Society. Bridgeman mentions one variety in 1832; Buist, in 1851, speaks of two varieties, but Salisbury, 1848,[4] describes three, and Bement,[5] 1853, two sorts. In Schenck's Gardener's Text-book, 1854, three varieties are named. In 1863 Burr describes nine, and in 1866, twelve sorts. In an illustrated article of my own, contributed to the *Rural New Yorker* for 1884, thirty-five varieties are described as distinct, and thirty-two are figured.

Sweet corn is not mentioned in Noisette's Manual Compleat du Jardinier, 1829, not by Bonafous in his folio work published in 1836, so we may assume it had not reached French culture at the latter date. In 1883 Vilmorin names seven sorts, all of which are American named.

[1] Travels, 1821, I.
[2] Husbandry, 1801,
[3] John Randolph.
[4] Trans. N. Y. Ag. Soc., 1848, 836.
[5] ib., 1853, 336.

Sweet Potato.—We do not hear of the sweet potato until after the discovery of America.[1] Clusius,[2] in 1566, first saw them in Spain,[3] and Oviedo records their introduction from the West Indies. Ramusio's Collection of Voyages was published 1563–74, and in the Portuguese pilot's relation, therein published, is, "The root which is called by the Indians of Hispaniola *batata*, is named *igname* at St. Thomas [coast of Africa], and is one of the most essential articles of their food."[4] The igname was mentioned at St. Thomas by Scaliger, 1566. It was grown by Gerarde in England in 1597, and is figured by Rheede as cultivated in Malabar, and by Rumphius in Amboyna, the latter asserting that they were brought by the Spanish Americans to Manilla and the Moluccas, whence the Portuguese diffused it through the Malay archipelago. In China Bretschneider tells De Candolle[5] that according to the Chinese books the sweet potato is foreign to China, and that the *Min-shu* published in the sixteenth century, says that the introduction took place between 1573 and 1620.

In America they are noted by many of the early voyagers, from Columbus onward. Asa Gray and Trumbull, *Am. Jour. of Sc.*, April, 1883, have collected the evidence. We may add to their references that Chanca, physician to the fleet of Columbus, in a letter dated 1494, speaks of *age* or sweet potatoes or yams as among the productions of Hispaniola,[6] and Pigafetta Vicentia, 1591, found in Brazil *batatas*, "they resembled turnips and tasted like chestnuts." Peter Martyr[7] describes many varieties, as does also Oviedo[8] and Garcilasso de la Vega,[9] this fact of variety indicating antiquity of culture.

Gray and Trumbull state that it had reached the Pacific islands

[1] One exception may be noted, but I have not opportunity of studying into the authenticity of the statement. In a Spanish MS., 1562, in the island of Palma, by John de Abreu de Gallineo, a Francisan friar, an account is given of the voyage of Betancon to the island of Ferro (Canaries) in 1405. "Their food was the flesh of goats, sheep and hogs; they had also some roots which the Spaniards call batatas." The identity of the roots appears to rest upon the opinion of the writer in 1562, after the introduction of the sweet potato and the American name.

[2] Hist. Rar. Stirp., 1576.

[3] A. Gray, *Am. Jour. of Sc.*, 1883, 247.

[4] Gen. Coll. of Voy. by the Port., Lond., 1789, 433.

[5] Origin of Cult. Plants, 58, note.

[6] Pharmacog., 452.

[7] Third decade Eden's Hist. of Trav., 1577, 143.

[8] Gray and Trumbull, l. c.

[9] Royal Com. Hak. Soc. ed., II, 359.

in prehistoric times, but give no evidence for the statement. I can find nothing which can countenance this belief except in the number of varieties that are cultivated in some islands, as thirty-three in the Hawaian islands.[1] The name *cumala* in New Zealand, and Otaheite,[2] and Fiji *kumara*[3] is strangely like the *cumar* of the Quito dialect.[4] We may add here that the *camote* of Yucatan was called in the islands *axi* and *batatas*.[5]

Tomato.—Tomatoes were eaten by the Nahua tribes, and were called *tomatl*,[6] and also by the wild tribes of Mexico,[7] and Hernandez[8] has a chapter "*De tomatl, seu planta acinosa* vel *Solano*, and describes several sorts under their Mexican name.[9] It was described by various European botanists of the sixteenth century, which indicates its introduction to Europe, and for this botanical history we may refer to Gray and Trumbull already cited. It seems to have been grown in European gardens as a fruit, from its first introduction, judging from the references in Dodonæus[10] and Gerarde,[11] but Parkinson, 1656, speaks of it as grown in England for ornament and curiosity only. In Italy Chauteauvieux, 1812, mentions their cultivation, on a large scale, for the Naples and Rome market. It is probable that their use was at first more general among southern nations, as we find that the Anglo-Saxon races were the last to receive them into the kitchen garden. Thus in 1774 Long[12] describes the fruit well, and mentions their often use in soups and sauces, and adds that they are likewise fried and served up with eggs. In 1778 Mawe and Abercrombie[13] mention five varieties as known, two of which are described as scentless and burnet-leaved, and add that they are eaten by the Spaniards and Portuguese in particular, and are in high esteem.

In the United States its introduction preceded by many years its use as we at present know it. It is said to have reached Phil-

[1] Wilkes, U. S. Ex. Ex., IV, 282.
[2] Cook's Voy., I, 199.
[3] Seeman, Fl. Vil.
[4] Markham's note in Cieza's Trav., Hak. Soc. ed., 234.
[5] Fourth Voy. of Columbus, Gen. Coll. of Voy. by the Port., 440.
[6] Bancroft, Native Races, II. 356.
[7] ib., I, 624, 653.
[8] Ed. 1651, 295.
[9] Gray and Trumbull, *Am. Jour. of Arts and Sc.*, 1883 p. 128.
[10] Pempt., 1583.
[11] Herbal, 2d ed.
[12] Jam., III, 773.
[13] Gardiner.

adelphia from St. Domingo in 1798, but not to have been sold in the markets until 1829. It was used as an article of food in New Orleans in 1812.[1] The first notice of it in American gardens was apparently by Jefferson,[2] who notes it in Virginian gardens in 1781. It was introduced into Salem, Mass., about 1802, by an Italian, but he found it difficult to persuade people even to taste the fruit.[3] Among American writers on gardening, M'Mahon, 1806, mentions the tomato, but no varieties, as "in much esteem for culinary purposes;" Gardiner and Hepburn, 1818, say: "make excellent pickles;" Fessenden, 1828, quotes from Loudon only; Bridgeman, 1832, says, "much cultivated for its fruits in soups and sauces." They were first grown in Western New York in 1825, the seed from Virginia, and in 1830 were not produced by the vegetable gardeners about Albany,[4] yet directions for cultivating this fruit appeared in Thorburn's Gardeners' Kalendar, 2d edition, New York, 1817. Buist writes that as an esculent plant in 1828–9 the tomato was almost detested, yet in ten years more every variety of pill and panacea was "extract of tomato."[5] Mr. T. S. Gold, secretary of the Connecticut Board of Agriculture, writes me that "we raised our first tomatoes about 1832, only as a curiosity, made no use of them though we had heard that the French ate them. They were called love apples." D. J. Browne,[6] 1854, describes six varieties and says, "the tomato until within the last twenty years was almost wholly unknown in this county as an esculent vegetable." In 1835 they were sold by the dozen in Quincy market, Boston.[7] In the Maine *Farmer*, Oct. 16, 1835, in an editorial on tomatoes, they are said to be cultivated in gardens in Maine, and to be "a useful article of diet, and should be found on every man's table." In a local lecture in one of the Western colleges about this time, a Dr. Bennett refers to the tomato or Jerusalem apple as being found in the markets in great abundance,[8] and in the New York *Farmer* of this period, one person is mentioned as having planted a large quantity for the

[1] *Prairie Farmer*, June 28, 1876.
[2] Notes, Trenton, 1803, 54–5.
[3] Felt's Annals of Salem, II, 631.
[4] Autobiography of Thurlow Weed.
[5] White, Gard. for the South, 312.
[6] Pat. Of. Rep., 1854, 384.
[7] Am. Gard. Mag., 1835, 437.
[8] Me. *Farmer*, Aug. 21, 1835.

purpose of making sauce.[1] In 1844 the tomato was now acquiring that popularity which makes them so indispensable at present, writes R. Manning.[2]

The summing of the above evidence seems to be that the esculent use of the tomato in America does not antedate the present century, and only became general about 1835 to 1840. At the present time sixty named varieties appear in our various seed catalogues, but many of these are synonyms. Of the sixty-four named varieties grown at the New York Agr. Exp. Station in 1883, over fifty may be called sufficiently distinct for garden purposes.

The tomato can escape from cultivation quite readily and become feral. In the fall of 1884 I saw "wild" tomatoes growing upon the rocky sides of a railroad cutting in New Jersey, a few miles from Jersey City, and these resembled the red cherry. Unger[3] refers to their occurrence on the Gallapagos islands. Wilkes[4] mentions several sorts in the Feejee islands, but whether wild seems doubtful from the reference. On Ascension island they are said to have become completely established all over the island,[5] and Grant mentions their occurrence in Central Africa, 7° 21′ S., and near swamps 4° to 5° S., the natives not yet having learned their edible quality.[6]

We have now completed our list of American kitchen garden plants, which includes the *alkekengi*, four species of *bean*, one species of *cucumber*, *Jerusalem artichoke*, *martynia*, two *nasturtiums*, *peppers*, *potato*, *pumpkin* and *squash*, *purslane*, *tomato*, *sweet corn* and *sweet potato*. From the list of kitchen esculents recognized by Vilmorin,[7] we can add the *pine apple*, *quinoa*, *Apios tuberosa*, *aracacha*, *pea nut*, *ysano*, *claytonia*, *spilanthes*, *œnotheria*, *strawberry* two species, *hop* and *oca* in two species. Of these the pineapple and strawberry are rather to be regarded as fruits, the Apios seems rather to be included as a desirable plant for trial than as actually cultivated, and the hop is a native of both worlds.

[1] Me. *Farmer*, Sept., 11, 1835.
[2] Hist. Mass Hort. Soc., 269.
[3] Pat. Of. Rept., 1859, 357.
[4] U. S. Exp. Exp., III, 35.
[5] Gard. Chron., 1855, 851.
[6] Speke's Nile, 576.
[7] Les Pl. Potageres, 1883.

MOURNING AND WAR CUSTOMS OF THE KANSAS.

BY THE REV. J. OWEN DORSEY.

NOW, as the Kansas are few, all the men of the tribe assemble and go on the war path; but formerly it was not so. Then a sufficient number of warriors could be raised from a few gentes, probably among the gentes connected with the deceased by blood or marriage. Then a pipe was given to one who was an important man in the tribe; and he fasted for six days before summoning the warriors to join him in the expedition.

An account of the ceremonies observed at the death of Hosasage, a Kansas, in the winter of 1882–3, will show the present customs of the tribe. The authorities from whom the information was obtained were the war captain of the tribe, Paha^{n}le-gaqli; Waqube-k'i^{n}, the chief of the Eagle gens, and Nixüdje-yiñge, the principal sacred man or doctor of the tribe.

As soon as Hosasage died, his father-in-law, Wakanda, went after Paha^{n}le-gaqli, the war captain. The old man said, "Hosasage is dead. Therefore I have come to tell you to take the sacred pipe." The reply was, "Yes, I will take the sacred pipe. I will also take the sacred bag." Wakanda returned home, reaching it as day was coming. Paha^{n}le-gaqli took the mysterious objects, and put clay on his face as a sign of mourning. He fasted, performing the ceremonies of the ancients. At day he took the pipe and went to the house of the deceased. Hosasage's affinities had laid out the corpse, placing the body in the house near the door, and with the head to the east.

A skin tent was erected outside, extending from the front of the house towards the east. Representative men from all the gentes entered the tent and took their stations, as in the accompanying figure, beginning with No. 1.

When Paha^{n}le-gaqli arrived he first stood at *C*. Then the body was brought from the house and placed at *B*, with the head to the east. Then Paha^{n}le-gaqli stood at *D*, where he wept a great deal for the dead. He could not touch the corpse or any other dead body.

After mourning for him a long time, he said, "I will sit still for four days, smoking the sacred pipe. Then will I wander about, and I will kill any animals that I find." Then he condoled with all present. After which Wakanda took the ghost *(sic)* from the corpse, and carried it back to the house, crying as he went. Then

Paha^{n}le-gaqli selected four young men to act as servants for himself and the warriors.[1] They were Gahia-ma^{n}yi^{n}, of the Turtle gens; Iɬuka-gaqli, the brother Paha^{n}le-gaqli, of the Black eagle gens; Tcehawale, or Shield, of the same gens; and Tadje-k'uwe, of the Qüya or Eagle gens. This last is the brother-in-law of Paha^{n}le-gaqli. All are Yata men, *i. e.*, men from gentes on the left side of the tribal circle. They were called djexe-k'i^{n}, or *kettle-carriers*, answering to the Osage ɬsexe-k'i^{n}. Next Paha^{n}le-gaqli desired four men to act as duda^{n}wayüla^{n}, *leaders of the expedition*, or qlets'age. They always decide what is to be done, as the duda^{n}hañga, or war captain, cannot do that. On this occasion the men chosen were Kibaqla-hü, of the Elk gens; Jiñgawasa, of the Qüya (Eagle) gens; Cu^{n}mikase (Wolf), of the Ibatc'e gens; and Wats'aji, of the Black bear gens. Three were Yata men, and the fourth was an Ictuñga (Right) man.

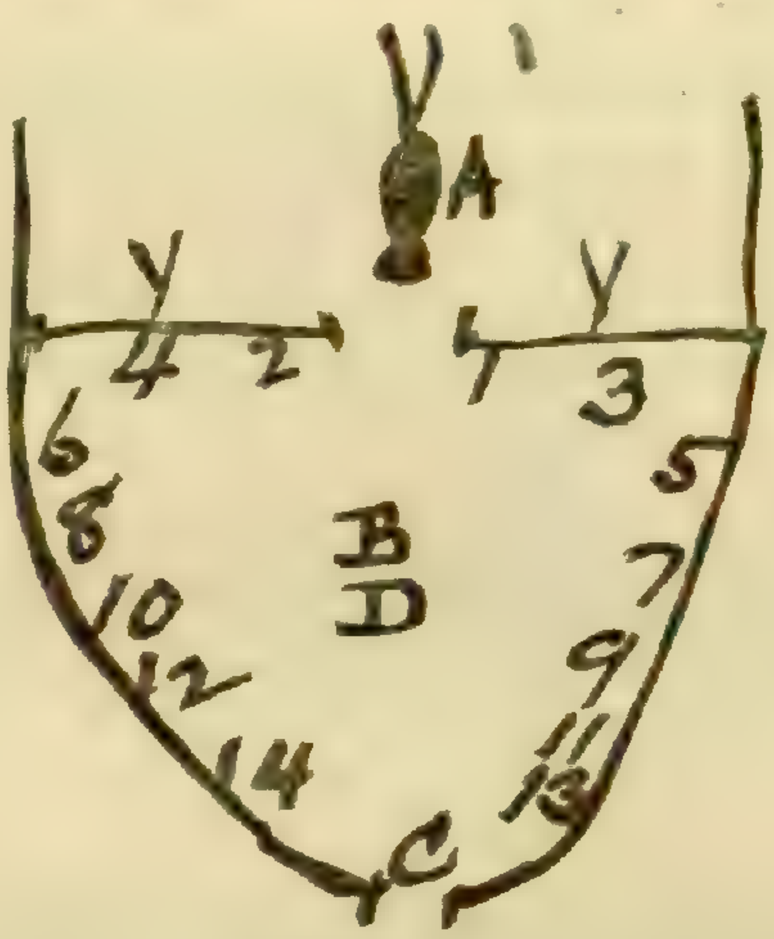


Fig. 1.

A. The corpse in the house.
2. An Upa^{n} (Elk) man.
4. A Qüya (Eagle) man.
6. A Ha^{n} (Night) man.
8. An Ibatce (Chicken hawk and Raccoon) man.
10. A Hañga-tañga (Black eagle) man.
12. A Tceduñga (Buffalo bull) man.
14. A Tciju Wactage (Peacemaker) man.

Y. The front of the house.
1. A Ma^{n}yiñka-gaxe man.
3. A Ta (Deer) man.
5. A Ka^{n}ze (Kansas, wind) man.
7. A Pañka (Red cedar) man.
9. A Wasabe (Black bear) man.
11. A Lu (Thunder) man.
13. A Ke (Turtle) man.

The directors consulted one another, saying, "Let us go on the war path in four days." Then they addressed Paha^{n}le-gaqli for the first time in their official capacity, "O war captain, let us go on the war path in four days." Then Paha^{n}le-gaqli announced their decision to all the others present, saying, "O comrades! in four days I will go on the war path."

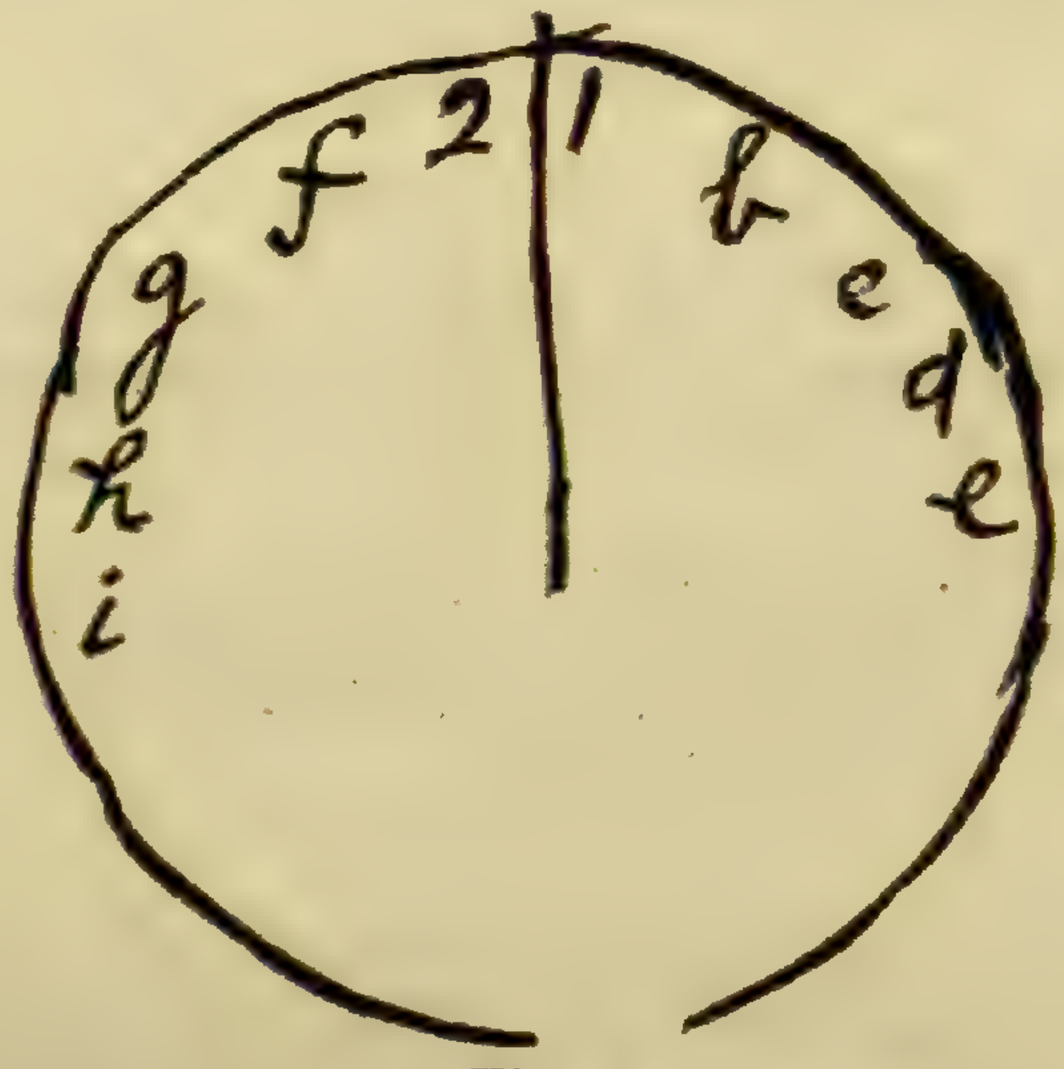
As a reward for his services Wakanda gave Paha^{n}le-gaqli a spotted horse, two red blankets, two white ones and a calico shirt. The two red blankets, one white one and the shirt were divided at once among the four directors. Then all present, ex-

[1] Nixüdje-yiñge says that there are six instead of four when the waqpele gaxe is performed.

cept Paha^{n}le-gaqli, returned to their homes. Paha^{n}le-gaqli could not go to his home for four days. He had told the kettle-carriers to make him a small lodge by the course of a small stream which used to flow near his house. This was done by Gahia-ma^{n}yi^{n} and Tcehawale. Paha^{n}le-gaqli was required to fast, wandering about and crying in solitary places, having clay on his face. At sunset his brother, Iɬuka-gaqli, brought him water. Then could the mourner wash his face and drink a cupful of the water, but he could eat no food. After sleeping awhile at night, he arose and put more clay on his face. At sunset on the fourth day the four directors went to the house of Paha^{n}le-gaqli and sent the four kettle-carriers to summon the mourner to his house. Then was he permitted to take food. The next morning he went for Gahia-ma^{n}yi^{n} and Tcehrwale. Before they arrived he and his wife left their house. He ordered them to invite the guests to his lodge. The messengers went in different directions, saying to each invited guest, "I have come to call you to go on the war path." And each man replied, "Yes, I will go with you." A lodge was set up near the house of Paha^{n}le-gaqli, and there the guests assembled.

Only two gentes met as such, the two Hăñga gentes, Black eagle and Chicken-hawk, but there were present the directors and kettle-carriers, some of whom were members of other gentes.

The following figure shows the seats of the Hăñga men in the lodge:



Chicken-hawk men.
2. Ali^{n}kawahu.
f. Cu^{n}mikase.
g. Wat'i^{n} li^{n}.
h. Mik'a-ha.
i. Ile-ha.

Black eagle men.
1. Paha^{n}le-gaqli.
b. Iɬuka-gaqli.
c. Nixüdje-yiñge.
d. Nu^{n}pewaye.
e. Qüyulañge.

Fig. 2.

Paha^{n}le-gaqli, who took his seat suddenly when the guests arrived, was present in two capacities, as war captain and as the

head of his gens; Cu^{n}mikase was there as a member of his gens and as a director; and Iɬuka-gaqle was there as a member of his gens and also as a kettle-carrier,

Only three were allowed to sing the sacred songs, Ali^{n}kawahu, Gahi^{n}ge-wadayiñga (who died in Jan., 1883) and Paha^{n}le-gaqli.

Two young men, one of the Turtle gens and one of the Qüya (Eagle) gens, attended to the sacred boiling (for the feast). Paha^{n}le-gaqli sent Tadje-k'uwe for the sacred clam shell, saying,

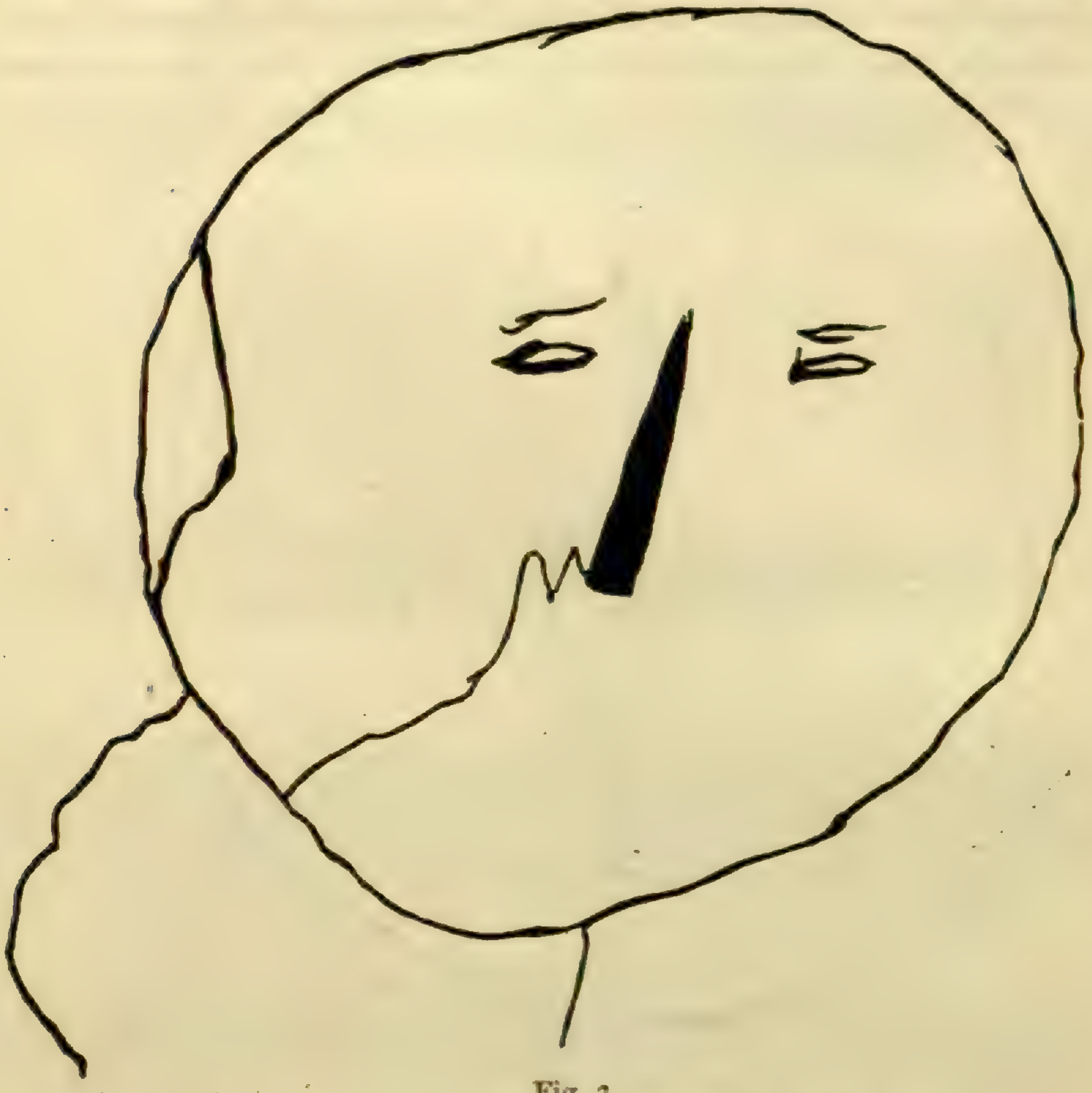


Fig. 3.

"I will take the large covering and the large bowl too. I will perform a sacred ceremony. Go for them." These objects were at the house of Paha^{n}le-gaqli, beyond the person addressed. The clam shell had been brought from the "great water at the east" by the ancestors of the Kansas. This was the case with all the sacred objects of the tribe, including the pipes and sundry roots used as medicines. The shell was opened and made like the face of a man, with eyes, teeth, etc. The above sketch was made by Paha^{n}le-gaqli.

When the sacred pipe is smoked by a Large Hăñga (Black eagle) or a Small Hăñga (Chicken-hawk) man, he must hold it in his right hand, blowing the smoke into the clam shell, which is held in his left. The smoke is supposed to ascend to the thunder-god, the god of war, to whom it is pleasant. There are five envelopes or wrappings for the shell, similar to those around the war pipe. All of the wrappings are called the "i^nhe-cabe." The inmost one is the bladder of a buffalo bull; the next is the spotted fur of a fawn; the third is matting made of the tall grass called sa; the fourth a broad piece of deer skin; the outmost one is interwoven hair from the head of a buffalo bull.

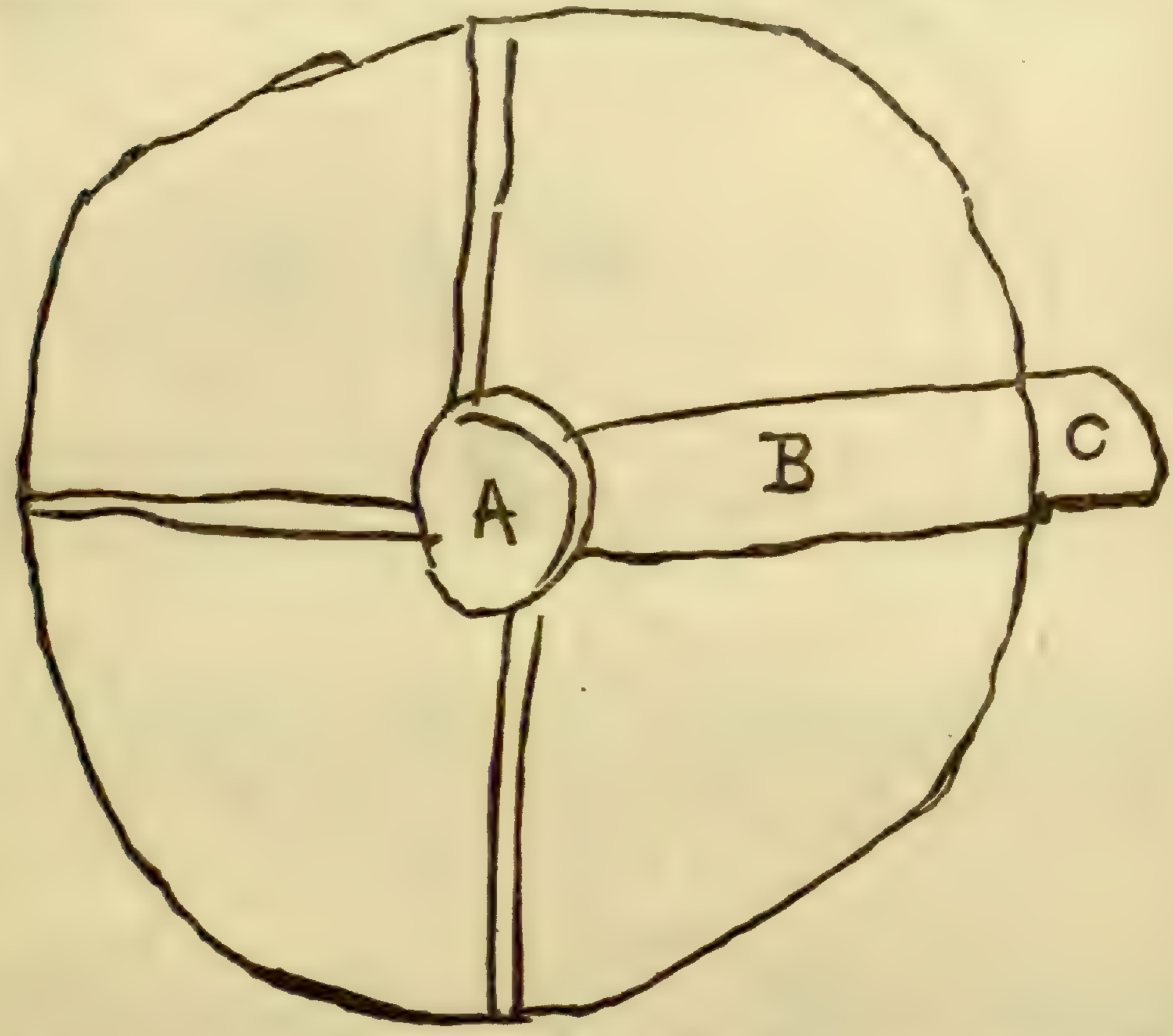


Fig. 4.

A. The bowl. *B*. The tube hollowed out through the stone, connecting the mouth-piece (*C*) with the bowl.

The war pipe was kept by Paha^{n}le-wak'ü (son of Ali^{n}kawahu), who died in 1883. It is made of red pipestone (i^nyi^n), and is called i^n-jüdge nanüŭ^{n}ba or nanüŭ^{n}ba jüdje. The stem forms part of the stone, being just long enough to be put between the lips. The stone is about the thickness of two hands (two or three inches). On each side of the pipe is an eye, that it may see the enemies. The opening of the bundle containing it is regulated by Ali^{n}kawahu. A figure of it is appended, showing its appearance on top.

The bundle containing the clam shell was brought by the young man who went for it, and placed before Paha^{n}le-gaqli. Ali^{n}kawahu took the bundle and began the sacred song. Paha^{n}le-gaqli soon joined him in the singing.

The accompanying chart used by these singers is a *fac-simile* of one drawn by Paha^{n}le-gaqli, who copied it from one he inherited from his father and father's father. There used to be many other pictographs on it. The Osages have a similar chart, on which there are fully a hundred pictographs. Paha^{n}le-gaqli said that there should be a representation of fire in the middle of his chart, but he was afraid to make it. The songs are very sacred, never being sung on ordinary occasions, or in a profane manner, lest the offender should be killed by the thunder-god.

Fig. 1 the sacred pipe, Waqube wakandagi. Three songs refer to it. They are sung when Ali^{n}kawahu removes the coverings. One is as follows:

"Ha-ha'! tce'-ga-nu' ha-ha'!
Ha-ha'! tce'-ga-nu' ha-ha'!
Ha-ha'! tce'-ga-nu' ha-ha'!
Hü-hü'! (Said when the envelopes are pressed down on.)

Chorus—Yu! yu! yu! Hü-hü'! Hü-hü'! (Sung by all the Black eagle and Chicken-hawk men.)

This chorus is an invocation of the thunder-god. In making it the arms are held up to the sky, being apart and parallel, with the palms out. Each arm is rubbed from the wrist to the shoulder by the other hand.[1] After the singing of these songs, Paha^{n}-le-gaqli receives the clam shell and puts it on his back.

Fig. 2, Ts'age-jiñga way$\breve{u}^{n}$, (Two) songs of the venerable man or Wakanda, the maker of all the songs. When Ali^{n}kawahu and Paha^{n}le-gaqli are singing these two songs, they suppose that he walks behind them, holding up his hands to the thunder-god in prayer for them. On the special occasion referred to in this paper, the expedition after the death of Hosasage, when these songs had been sung, Paha^{n}le-gaqli shifted the shell from his own back to that of Jiñga-wasa, one of the directors. He then ordered another man, Tayé, to put the I^{n}he-cabe on his back.

[1] This song and invocation is used by the Ponkas.

Fig. 3, song of another old man, who holds a cane. It is this Wakanda who gives success to the hunters. He is thus addressed: "Ts'áge-jiñga haú! Dáble ma^{n}'yi^{n}-aú'! Dáda^{n} wadjü'ta níkaci'ga ckéda^{n} wáyakípa-báda^{n}, ts'éya-bánahaú!— *O venerable man! Go hunting! Kill whatever persons or animals you may meet!*" They think that this being drives the game towards the hunters.

Fig. 4, Tadje wayu^{n}, wind songs. The winds are deities; they are Báza^{n}ta (*at the pines*), *the east wind;* A'k'a, *the south wind;* A'k'a jiñ'ga or A'k'uye, *the west wind;* and Hnita (*towards the cold*) *the north wind.* The warriors used to remove the hearts of slain foes, putting them in the fire as a sacrifice to the winds.

Fig. 5, songs of the large star (Venus), which is a Wakanda or god.

Fig. 6, Ja^{n}-mi^{n}dje wayu^{n}, bow songs. This is the bow of a Wakanda, probably that of the old man who aids the hunters.

Fig. 7, song of sacrifice to the deities. The sign for this song is a hand of which four fingers are seen. As this is sung some gift is thrown down and left as an offering to the Wakanda, and to all the deities, those above, those under the hills, the winds, Venus, etc.

As Ali^{n}kawahu and Paha^{n}le-gaqli are Yata people, they elevate the left hands, beginning at the left with the east wind, then turning to the south wind, next to the west wind and lastly to the north wind. To each they say, "That I give to you, O Wakanda!" They used to pierce themselves with knives or small splinters, and offer small pieces of their flesh to the deities.

Fig. 8, deer songs. Fig. 9, an elk song. Fig. 10, seven songs of the old man or deity who makes night (songs).

Fig. 11, five songs of the big rock. This is a rough, red rock near Topeka, Kan. It has a hard body, like that of Wakanda. "May you continue like it!" is the prayer of the singers.

Fig. 12, four wolf songs. The wolf howls at night.

Fig. 13, five moon songs. The moon shines at night.

Fig. 14, four crow songs. The crow flies around a dead body that it wishes to eat.

Fig. 15, Two songs of the yarn belt. This kind of belt was worn by the old men over their buffalo robes.

Fig. 16, song of an old man or deity. Fig. 17, three noon songs. Fig. 18, two shade songs. The shade is made by a

PLATE XX

Chart used by the Kansas.

deity. Fig. 19, a dream song. There is a deity who makes people sleepy. Fig. 20, song of the small rock.

Fig. 21, three songs of a tribe of Indians who who resembled the Witchitâs. The Kansas used to fight them. The two locks of plaited hair are not symbolic. Their faces are marked thus:

Fig. 22, two songs of the new moon. Fig. 23, ten songs of the buffalo bull. Fig. 24, planting songs. Fig. 25, cooking songs. The old man takes water in the kettle for boiling the corn and for drinking. Fig. 26, songs about walking with stilts. The Kansas used to walk on stilts when they forded shallow streams. Fig. 27, three owl songs. The owl hoots at night.

All the men had picketed their horses outside the lodge before the singing of the songs, and they had brought in their saddles.

After the singing Paha^{n}le-gaqli lighted and smoked the war pipe, and then handed it to all the others. After smoking they slept there. When the sky was getting light, before sunrise, the men took clay which they rubbed over their faces. All rose to their feet within the lodge and cried. They ceased crying when the sky became white. They went out, put the saddles on the horses, mounted them and departed. Paha^{n}le-gaqli kept far behind the others. All cried. By and by they reached the other side of the Arkansas river; then they reined in their horses and dismounted. Paha^{n}le-gaqli took the clam shell and gave it to one of the four directors to carry on his back. Subsequently they killed five prairie chickens. Thus was life taken, and the mourners were satisfied. They went on till they reached a small stream, beside which they encamped. A fire was kindled and the two kettle-carriers who had made the small lodge at the first, went for water; they gave water to all the warriors, who washed off the clay from their faces. They ate the prairie chickens and then started homeward. All returned to the house of Paha^{n}le-gaqli, where his wife put a kettle on the fire and gave them a meal. All partook of it and then separated, going to their respective homes.

According to Nixüdje-yiñge, two qlets'age were chosen for each side of the tribe. They carried on their backs thread or sinew for mending their moccasins, and corn and squashes in

bags. The war captain had a tobacco pouch of skunk skin. When he smoked he was ever praying, "O Wakanda! I wish a Pani Loup to die!"

The war captain made one of the qlets'age carry the sacred bag before the ceremony of "wáqpelé gáxe" was performed. On this occasion there were six kettle-carriers instead of four. When the qlet s'age carried the sacred bag two of the kettle-carriers carried a bundle of sticks apiece, which they laid down on the road, one end of each bundle pointing towards the land of the enemy. Four of the kettle carriers remained still. The next morning all the warriors went to the spot; they drew a circle around the bundles and set up one stick within, which they attacked as if it were a Pani. This might cause, in their opinion, the death of real foes. Members of the Lu, or Thunder gens, could not take part in this ceremony, but were obliged to keep in the rear. The following prayers were said during the wapqele gaxe, according to Nixüdje-yiñge: "I wish to pass along the road to the foe! O Wakanda! I promise you a blanket if I succeed!" This was said facing the east. Turning to the west the following prayer was made: "O Wakanda! I promise you a feast if I succeed!"

On the return from war, during the scalp dance which followed, the wife of the war captain held the scalp and the war pipe as she danced.

U'ce-gu^{n}ya, an aged man of the Black bear gens, told the following: In former days when a man lost a child he cried for it, and became a war captain. Two persons built him a small lodge and filled a small kettle with corn. When the corn was boiled, which was about dark, the captain gave a little of it away, but he ate none. He fasted because he wished to kill an Indian. The warriors departed the next day. The kettle-carriers took corn, meat, moccasins, small kettles and spoons. During the "waqpele gaxe" the following petitions were made. "I wish to kill a Pani! I wish to bring back horses! I wish to pull down a foe! I promise you a calico shirt! I promise you a robe! I will also give you a blanket, O Wakanda, if you let me come home after killing a Pani!"

War Dances.—There are two dances before going to war, the Maka$^{n'}$ watci$^{n'}$ and the Wacábe watci$^{n'}$. The former may be danced at any season. It is designed to increase the warlike spirit

of the men. The following diagram shows the position of the different actors:

The fire or fireplace is in the middle of the lodge.
c. Four women on each side.
d. The men.

A. The principal keeper of the maka^{n} or medicine.
B. His two assistants.
e e. Two servants or messengers.

Fig. 5.

The Wacabe watci^{n} is danced four days before going on the war path, in warm weather. There are about forty followers besides the leaders. They divide into two parties of equal numbers and dance out of doors, around the village, half going in one direction and half in the other. Each of the four qlets'age carries a standard or waqléqle skă, made of swan skin (mi^{n}xa-ha). Two of these men are in each party. The he wáqleqle or wacábe, from which the dance takes its name, is borne by the wadjipa^{n}yi^{n} or village crier, a member of the Deer gens. When they start on the war path the qlet s'age go horseback, carrying their standards.

The two dances after returning from war are the Watce watci^{n} or scalp dance, danced by the women, and the Ilucka watci^{n}, danced by the men alone.

Other Burial and Mourning Customs.—When Wm. Johnson, a Kansas, died, he was buried by his wife, his sister and his sister's daughter. As the widow did not wish any of the tribe to go on the war path, she did not send for Paha^{n}le-gaqli. So neither he nor the other men assembled at the house of the deceased, as in the case of Hosasage.

When a man's wife dies, the husband must put earth on his face at daybreak, and wander about till sunset, bewailing his loss. He must fast from sunrise to sunset for a year and a half. After sunset he washes his face. and can eat and sleep. At the end of the period of mourning, the widower says to his wife's brothers, "I will give you a horse, a red blanket, a white blanket, a calico

shirt and a kettle." One of them replies, "Yes, my sister's husband, that is good." The presents are made the next morning at daybreak. The elder brother-in-law takes the horse, and the next receives the other gifts. At noon the widower washes his face and seeks another wife.

In like manner when a woman loses her husband she must put earth on her face and fast during the day from sunrise to sunset for a year. She too can eat after sunset. At the end of the year she brings the gifts to the sister and younger brother of her husband. The sister gets the horse and the brother takes the rest.

When a widower does not make presents to the kinsmen of his deceased wife before marrying again, he is sure to provoke the anger of his brothers-in-law. Formerly an old man took a gun and shot at his sister's husband for this reason. And another man, when the Kansas were south of Council Grove, Kan., took a knife and gashed the head of the offending man in several places. Therefore widowers are accustomed to observe this rule of making presents, fearing the punishment which their offended affinities might inflict on them.

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THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 542, June number.)

II. The Nervous Mechanism.

IN all the higher animals a system of fibers and cell masses forms the channel by which external energy enters the body, and is distributed to its every organ and tissue. There is considerable variation of form and condition in this apparatus, but it is essentially a single organic agent, and includes the muscles as part of its organism. There is little apparent differentiation in the fibers. The main differentiation is in the endings of these fibers. Of these endings a very great number exist on the surface of the body, where they are variously modified and adapted to different purposes. These are the receiving organs, through whose aid external energy reaches the conducting fibers. They are varied to receive every form of external energy. This energy beats upon the surface of the body in at least six forms or modes. One of these is that known as ethereal vibration, through which far distant objects make themselves felt. Part of these vibrations

enter the body through a specially organized nerve apparatus, the rods and cones of the eye. But they all, as radiant heat, enter at every part of the surface, by aid of less specialized nerve endings. Heat in another condition, the static vibrations of contiguous matter, also enters at every part of the surface, presumably through the same channel. A second series of vibrations, those of ponderable matter, enter by the channel of the ear, through the aid of an intricately organized apparatus. In addition to these three conditions of vibratory influence there are three modes of direct contact through which motor energy also makes its way into the body. These are solid, liquid and gaseous contact. Gaseous contact enters by a special channel, that of the nerves of smell, which are excited by the touch of excessively fine material borne on the air current. Liquid contact finds its special channel in the nerves of taste, which are only sensitive to the direct touch of liquified or dissolvcd matter. Solid contact has the whole surface for its field. The nerves of touch, indeed, are also sensitive to liquid and gaseous contact if exerted by matter in motion, but mainly respond to the contact and pressure of solid matter.

The internal extremities of the nerves lack the variety of their surface endings. They are distributing organs as the latter are receiving organs. The energy received varies greatly in character, and needs considerably varied apparatus for its reception. That distributed has become far more homogeneous and can be dispersed by a single apparatus. This is the muscle fiber, which, though not ordinarily considered so, is essentially but a nerve ending, an aggregation of unstable chemical molecules around the extremity of a nerve. And the combined aggregates of these fibers, which constitute a muscle, are but a mass of nerve extremities ending in matter which is adapted to set free a considerable volume of motor energy.[1] Into this matter the energy which has traversed the nerves is discharged, and there instigates an active chemical change and a rapid freeing of energy, with animal motion as its result.

Such is reflex action, a frequent mode of nerve action in man, and possibly the only one in many of the lower animals. Motor energy differing greatly in character and source is thus forced to produce a single effect, that of muscular contraction and animal

[1] See Organic Physics, AMER. NAT., Feb., 1883.

mass motion. But in all the higher animals other effects are produced. All the nerve fibers enter cells or masses of cells called ganglia, though there is no evidence that they end there. There is some reason to believe that they simply pass through these cells, with a reduction of diameter, and perhaps a division into branches. All we can be sure of is that the motor energy which they carry inward does not all pass through these ganglia, but that much of it is arrested in its course and there distributed. And in this distribution an interesting feature of the case is, at least so far as the cerebral ganglion is concerned, that the motor energy retains the peculiarities it possessed before entering the body, or something equivalent to them, and impresses a permanent record of each such peculiarity upon some internal tablet. Only when this energy continues its course over the nerves to the muscles does it lose its individuality and merge in the general outflow of muscle energy.

As we descend in the animal kingdom it is to find this complex apparatus of sensation and motion gradually simplify. The sensory nerve-endings and their organs grow less intricate, and their susceptibility is diminished. Some of the organs of special sense completely disappear, and the power of the others becomes little more than a modified touch. In very many cases the body is covered by a rigid armor, and the influence of external energy is limited to a small region of the surface. Finally the special senses disappear, apparently the last to vanish being that of sight, which is reduced to a vague discrimination between light and shade. The cerebral ganglion grows less and less marked, and disappears as a special organ. Finally the nerve and muscle fibers vanish, one of their last traces being the single cell which, in the Hydra, appears to function both as nerve and muscle. On reaching the Protozoa we find forms quite destitute of sensory and motor organs. And yet sensation and motion persist. These powers seem to be native to protoplasmic matter, however aggregated, and are displayed even in the plant cell wherever it is so situated that its protoplasm is exposed to external energy.

Yet late discoveries in regard to the constitution of the cell prove it to be by no means the simple homogeneous structure formerly supposed. The division into nucleus and outer cell has been traced to a very low level, and perhaps exists at the lowest level. And the nucleus, and to a less marked extent the outer

cell, are now known to be heterogeneous in structure, composed of at least two distinct substances, one of which exists as very minute fibrils, of which the other occupies the interspaces. This organization, very well marked in the cells of the higher animals, becomes much less so in the Protozoa, and is only clearly distinguishable in their higher representatives. Yet this is probably due to the imperfection of instruments and methods. The nervous structure has been only recently discovered in the Medusæ, and has not yet been traced in the stem of the compound Cœlenterates, though this conveys sensory impulses, and doubtless contains communicating fibrillæ. In like manner the fibrillar structure may exist in all cells, though not always sufficiently defined to be discoverable.

Again the cilia, so common in the single-celled life forms and in many of the surface cells of higher animals, have been traced in some instances into direct connection with the fibrillæ. Perhaps in all cases they are external continuations of the fibrillæ, and may thus function as the primitive nerve-ending, the sensory termination which receives impressions of external motor energy and transmits it to the fibrillæ to be distributed throughout the substance of the cell. There is thus some reason to believe that the developed motor apparatus of the highest animal has its primitive counterpart in every cell, and that the unfolded nervous and muscular organism of man is but a direct development of that existing in the Infusoria. In Amœba the pseudopod may function as a sensory organ and receive motor impressions which are distributed throughout the cell mass. Tissue contraction seems to be the general result of such motor influence, however received and distributed.

Late research indicates the method of development of this primary motor apparatus. It has been clearly shown that fine threads of protoplasm connect contiguous cells in frequent instances. Observers have seen this structure in the cells of numerous species of plants, and some writers look upon it as universal in plant cells. In addition to the protoplasmic threads which join the nucleus to the cell wall, others pass through the wall, probably through minute apertures, and connect with the protoplasm of one or more neighboring cells. Possibly this may be a result of cell division. When one cell separates into two its protoplasm may not completely separate. And it is quite conceivable that

this net work of protoplasm, which connects all the cells of many and possibly the active cells of all plants, may have a nervous function, though the conditions of plant life are such as seldom to call it into exercise.

In animals a similar structure has been observed in many cases, and particularly between epithelial cells, where it is most likely to be called into functional activity. Some observers claim that it is general, and that the animal body is an intricate net work of fibrillæ, of which the cells forms the nodes. This doctrine, though it has been strongly combatted, is certainly not without considerable support in observation, and there is good reason to believe that such continuity of protoplasm exists between the cells of at least several of the animal tissues.

Thus the primitive motor organism quite probably exists with little change throughout the highest animals, and may serve to bring every cell within the reach of motor influences, as the similarly minute vascular structure has a like result in regard to nutritive influences. The conditions here indicated, however, exist in very different degrees of perfection in different cells. In some tissues they may almost or quite have ceased to exist through lack of exercise. In nerve tissue, on the contrary, they are remarkably well developed. The large nerve cells of the ganglia possess an intricate fibrillar structure, so distinctly developed that it was clearly recognized long before any one imagined that such a structure was a common feature of cells. And the extrusion of protoplasmic threads through the cell walls, in direct continuation of the internal fibrils, is equally well marked. The whole surface of some of the cells is covered with a series of fine nerve rootlets. Yet greatly developed as this structure is, there is no reason to doubt that it is a direct unfoldment of the general cell structure, with its nuclear and outer cell fibrils and its one or more protoplasmic threads running to neighboring cells. In the case of nerve tissue the rootlets also connect with other cells, but the connected cells are often separated by very considerable intervals. Very likely this separation is a result of natural selection. In original Metazoa sensory impressions may have passed from cell to cell through the aid of their connecting protoplasmic threads. In forms in which no nerves can be discovered this method may still continue, as a slow yet sufficient process. But as animal life developed the connected cells seem to have become

more and more widely separated, the fibril growing thicker and becoming a nerve fiber, with the power of conveying motor energy more rapidly and in greater quantity. Through some such process successive steps of evolution may have led to the condition now existing in the highest animals, with very numerous fibrils emanating from the cells, their combination into bundles with an insulating covering, and their final distribution to distant cells.

For this idea we have a degree of embryological warrant, and can trace the nerve organism to one of its ancestral stages. For, as observed by Beale, the cells from which the nervous system arises form processes which connect adjacent cells together. They are thus direct counterparts of many, and perhaps of all, tissue cells. As growth goes on these cells separate, while their connecting processes lengthen and form the axis cylinder of the nerve fiber. In this we seem to perceive the phylogenetic development of nerve tissue. Eventually, as some observers consider, one of these cells becomes a cell in a nerve ganglion, the other a peripheral end organ, their connecting process being lengthened out into a nerve fiber. That in this we have an exact representation of the mode of development of nerve tissue, however, is far from certain. If so we should find each nerve fiber proceeding directly from one to the other extremity without intermediate ganglia. The frequent existence of these ganglia leads to another conclusion, and indicates that the original development pursued another line, which has been slurred over in the rapidity of unfoldment like so many embryological characteristics. Various hypotheses of the mode of development of nerve tissue have been heretofore offered, the most notable being that of Herbert Spencer, but these are mainly philosophical. Still another may be offered which is in direct consonance with the recent discoveries in cell and tissue formation above described, and which future embryological research may fully substantiate.

The hypothesis which we propose is the following. We have seen some reason to believe that in single-celled animals the motor impressions received by the cilia or otherwise are distributed throughout the cell by the fibrillæ. This distribution is at first general, but in case of special motions may become special, certain fibrillæ becoming specially capacitated, through exercise in this function, to convey the current. In Metazoan animals

the connecting threads of protoplasm between the cells are doubtless competent to convey motor impulses from cell to cell, and they very probably preceded the development of nerves as a sensory arrangement, permitting a slow and general transmission of motor influences to every part of the body. But if any particular motions became habitual, through natural selection, the sensory inflow must have become to some extent specialized, following certain channels of conduction more frequently than others. But nutrition always attends activity, and in these special lines the fibrils must have grown larger and more capable. If their labor still increased, a second change must have succeeded. The line of special conduction being mainly composed of cells, with short interconnecting fibrils, a modification necessarily took place in the cells also. If the outer threads had continuous fibrillar connection through the cells, which we have some warrant to assume, these cell fibrillæ must have grown larger and straighter as a result of extra nutrition and natural selection. They may, indeed, have exhausted the cell nutriment and caused the abortion of the remaining filaments. In short, a continuation of this process of evolution may have caused the gradual disappearance of most of the cells in the line of conduction, and the conversion of their fibrillæ into direct continuations of the developing nerve fiber.

The make-up of the axis cylinder of every nerve fiber is in strong corroboration of this idea. It is found to consist of numerous extremely delicate fibrillæ imbedded in a finely granulated substance. Nuclei are also found in it. Thus it is closely analogous to the cell in composition, and presents strong indications of originating in a connected line of cells. Another feature of the nerve fiber is an interesting confirmation of this. The medullary sheath seems but a special elongation of the outer layer of the cells. It does not exist in the primitive nerve, of which we have probably a survival in the nerves of the sympathetic system. It seems the result of a fuller development, yet the fatty and albuminous matters of which it consists are the substances which exists most abundantly in the outer cell layer. Conversion into fatty matter is a general characteristic of deteriorating cells. Thus every portion of the nerve fiber can be traced directly to the cell, with singularly little change, and there is certainly much reason to believe that nerve conduction is an outgrowth of a

primitive connected-cell conduction. All these cells did not disappear or suffer conversion. Some were retained, perhaps as centers of distribution, by whose aid a single inflowing current could be sent off in several directions as a partial survival of the original general distribution. And significantly, near these cells the axis cylinder is naked. The cell matter has not been converted into a medullary sheath. Yet more significant indications of such an origin of the nerve system are seen in the *bipolar* nerve cells. In these a nerve fiber enters the cell on each side, and its fibrillated structure is clearly continuous with the fibrillæ of the cell. And in many cases the medulla of the fibers is continued over the cell. Such a cell, therefore, appears to be a survival of the primitive nerve, and indicates its origin, as above conjectured, from a line of cells with protoplasmic fibrillar connections.

There is one more point here to consider, that of the termini of the nerve fibers. It is quite probable that they never terminate in the ganglionic cells, not even in those of the cerebrum, but that they connect with the fibrillæ of these cells, which in their turn connect with outgoing fibers. Nor is it by any means sure that they have actual termini in the peripheral and muscular cells. Indications point to the contrary. In many cases they seem to pass continuously through these cells and rejoin the exterior nerve fibrils, or to end in a plexus whose fibrillæ are probably continuous. Thus in the highest development of nervous tissue there is singularly little change in structure from the condition of undifferentiated cell tissue.

We may look upon the function of the nerve fibers as simply conductive, though it is possible that they add to the strength of the motor current through chemical change which takes place in their tissue. What is the function of the nerve cells? Very probably their action resembles that of the electric resistance coil. In telegraphy by decreasing the diameter of the wire the passage of the current is resisted, and part of it loses its electric character. By suitable contrivances this checked current may be converted into heat, light, magnetism or other forms of force. In the nerve cells the minute fibrillæ over which the current must pass seem to have a similar function. Part of the motor energy is converted into some other form of force. It may become heat. It may outflow into the high-atomed muscle molecules and cause chemical change. Or it may assume some other condition, as it

very evidently does in the cerebral cells. There are possibly no actual nerve termini anywhere within the body, but simply occasional resistance nodes, in some of which a single inflowing current may be divided between several outgoing channels, but in many or all of which the current is checked and partly converted into some other mode of motion.

It is not necessary here to go into any minute description of the nervous system. In man it is virtually double. In addition to the external sensory and motor system, there is a secondary system which is devoted to the needs of the digestive cavity and to other internal duties. These systems are similar in general make-up, consisting of ganglia and communicating fibers, which extend partly to muscles and partly to the epithelial layer. But they have marked differences. The sympathetic has no central ganglion answering to the cerebrum. Its operations are all performed without consciousness except through the occasional aid of its cerebral nerve connections. And in its nerve fibers the axis cylinder is destitute of a medullary sheath. Some writers consider that its operations may have been originally conscious and have become unconscious and simply reflex through incessant repetition. Yet this is very doubtful. It presents every appearance of being a survival of a primitive nerve condition, beyond which it has not greatly developed. Consciousness is a condition that must have been originally vague and generalized, and which but slowly grew specialized with the gradual centralization of the nervous system. We cannot imagine it as retrograding and disappearing in any developing nervous system. In fact, the system of intestinal nerves has never become centralized and definite. Such consciousness as it may possess retains its original vagueness. Its functional existence is perhaps as ancient as that of the external nerve system, but its development has been much slower. When the latter had advanced to the condition of distinct nerves and ganglia, the former yet remained in the primitive stage of cell conduction. The nerves of external sensation have gained an insulating sheath while those of intestinal sensation remain naked. The one has become definitely centralized while the other yet lacks special organization. These results flow from their difference of duties, which in the one case are simple and unvarying, in the other complex and excessively varied. As a result such consciousness as may exist in the intestinal system

retains the dim vagueness which probably exists in animals of a very low grade. But in the cerebro-spinal system consciousness has become sharply centralized and defined. The peculiar condition which we call consciousness may have its roots very low down in the soil of nature as a highly generalized accompaniment of motor energy. In the evolution of higher forms and conditions it has grown steadily more specialized, until, in the central nerve organ of man, it has become a concentrated, developed and sharply defined condition, the necessary accompaniment of an equally special centralization of substance and energy, which we name the mind.

The cerebro-spinal nerve system in man and the higher animals has become a highly differentiated and complex organism, whose make-up may be very briefly described. The sensory nerves, which convey motor impressions from the various points of the surface, pass through a series of spinal ganglia in their upward journey toward the brain. Here they enter the great ganglia at the base of the brain, to which the nerves of some of the special senses pass directly. From here they communicate with the cerebrum, though whether directly or indirectly is not certain. It is certain that when the cerebrum is removed many of the sensory nerves are found to be in direct communication with those of motion. It is almost equally certain that in ordinary cases many sensory impressions are directly passed on to the motor nerves, with or without consciousness. These intermediate ganglia, then, may perform a special duty in the economy which we will consider further on. From the cerebrum motor nerves enter these ganglia, from which the same or other motor nerves emerge and pass onward, mainly by the route of the spinal ganglia, to the muscles.

According to M. Luys[1] the cerebral organ is composed of a vast array of fibers which diverge to enter a hemispherical sheet of gray or cellular nerve matter. This gray sheet is greatly wrinkled and folded so as considerably to increase its superficial extent. It is of no great thickness, and is composed of successive layers of nerve cells connected by fibers, these cells being smaller in the surface layers and growing larger in the deeper layers. The hemisphere is really a double mass, since it is divided in the middle line of the body, the two halves being con-

[1] The Brain and its Functions, International Scientific Series.

nected by a thick commissure of nerve fibers. The cerebral cells are pyramidal in shape, the summit of the pyramid being directed upwards. Each of these cells gives off a delicate fringe of fibrils like the fine rootlets of a plant, which spread out in an interlaced network and form a continuous fine plexus. These fibrils are believed to be the origin of the sensory nerves, becoming aggregated and covered with a medullary sheath. In addition to the processes which thus break up into rootlets of protoplasm, there is always one at least which does not thus subdivide but continues as a defined nerve fiber from the cell outward. This is believed to be the origin of the motor nerves. The above beliefs, however, as yet need substantiation in discovery.

Midway in the cerebral organ, occupying the center of the hemisphere, are two oval-shaped bodies, known respectively as the optic thalamus and the corpus striatum. Each is composed of several ganglia, the first being connected by nerve fibers with the posterior, the second with the anterior portion of the spinal chord. These, according to the hypothesis of M. Luys, are intermediate stations for the nerve currents. All the sensory nerves of the body are gathered into the ganglia of the optic thalamus, from which they are again distributed to the cerebral lobes. The return nerves from these lobes are, on the contrary, gathered into the corpus striatum, from which they are distributed to the muscles of the body. It is not necessary to give the somewhat questionable conclusions which he draws from this mechanism of the cerebral nerve system.

If now we trace the nervous system downward through the different classes of the animal kingdom, its complexity of organization is found to gradually decrease. A head ganglion, sending off nerves to the organs of special sense, is found to exist in the arthropods and the higher mollusks and annelids, but it has lost the distinctive features of the vertebrate brain. There is no longer a separate cerebral organ above, and only connected by fibers with, the ganglia which directly receive sensation and control motion. Only the analogue of the basal vertebrate brain seems to exist in these lower animals. In the Vertebrata the cerebrum may be removed without detriment to the functions of animal life, and possibly without entire removal of consciousness. In this condition a vertebrate animal may be in nervous analogy with the normal condition of the lower animals mentioned, though

from lack of dependence on its lower head ganglia, in the normal state, these possess no specialized powers of consciousness.

At a still lower level in the animal world all clear indication of nervous centralization disappears. Ganglia still exist but perhaps only as agents to draft off the sensory currents of energy to the various muscles. There probably exists a vague consciousness, but no condition that can be called psychical. The nerve system in these creatures has sunk to the level of the sympathetic in man. Still lower every trace of a nervous system vanishes, though probably continuous lines of cell protoplasm yet exist extending generally throughout the body. This condition can be traced down into vegetable life, and particularly into the Algæ, whose generalized cell substance and lack of indurated covering renders every portion of them subject to the inflow of external energy. The fibril of the cell thus seems to be the germ of the nerve apparatus of the fully developed animal.

It may be noted in conclusion that in the hypothesis of nerve development here advanced is avoided the necessity of the long and intricate explanation of nerve genesis offered by Herbert Spencer. In this view the nerve fibril is a constituent part of every cell, and the nerve and muscle function of conduction and contraction is performed by the Protozoa. In all animals of the many-celled character the protoplasmic connection between the cells functions as the primitive nerve fiber, and each cell as a primitive ganglion. Nothing further than development of this primordial apparatus is requisite as the animal race develops. And even in the most highly developed nervous system the line of its phylogeny is evident in the mode of formation of the fiber, and the character of its connection with the ganglion cell. All that is further requisite is conductive specialization, the restriction of each special impression to a special line of conduction. And natural selection has doubtless been the agent in producing this effect.

(To be continued.)

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The cultivation of pure science is most successful when pursued from non-utilitarian motives. In persons who cultivate it in this way it has a sentimental as well as an intellectual origin.

Sometimes this is the desire for "more light;" in others it is the love of the beautiful in thought and in nature. In all minds it comes from brain-hunger, which may be the craving of a rational mind for a rational explanation of phenomena, or the mere necessity for grist felt by an ever-running conscious mill. To such minds money is only valuable as it enables them to satisfy these needs, and the gratification of such a mind-thirst is more to them than money can bring in any other direction. So it is with the true artist. The sensitiveness to the beautiful in nature or in idea, must find expression in proportion to its intensity, and in so doing it finds its reward. These are phases of the intellectual life which, if our race follow the usual course of evolution, are to become far more general than they are at present. It is very desirable that they should become more general, for they furnish sources of pleasure that cannot be obtained in any other way. The sentiment that loves knowledge is akin to the divine, for its sustenance is truth, and error is discarded at whatever sacrifice. It has faith enough in the order of the universe to see its innermost secrets unfolded, for unsuspicious of evil, it does not expect to find it predominant. It breathes good will to men, for it feels sure that with full knowledge evil may be avoided so as to be practically destroyed. In such a pursuit human nature is ennobled; and to respect our kind is to crown human intercourse, and to elevate social life to an ideal level.

What are the tendencies of society in this direction in our country? Is it not time to repeat the verity that "a man's life consisteth not in the abundance of the things which he possesseth?" Does the accumulation of material property constitute the highest achievement of the human mind? Does the care of the appurtenances of mere living constitute the noblest occupation of man? An affirmative would seem to be the verdict of the present generation in many places. We hope this state of things may not last. The hunger and thirst of the full-grown soul will demand satisfaction, and will some day fling aside the less worthy ideas which its larval stage have imposed upon it. It will more and more emerge into a fuller understanding of its relations to the universe, and a corresponding appreciation of its privileges and its duties. To such persons life has a worth which material possessions cannot give. Nothing on all the varied face of nature is devoid of meaning. Our fellow beneficiaries of the great realm

of life acquire a new interest in our eyes. The nobility of man becomes more evident, and the repugnance to all that is out of accord with the evident design of the processes of evolution becomes habitual. For those who still remain in primitive conditions of thought such can labor and wait, well knowing how glorious is the harvest. To those who do not love to learn they can say with charity, "forgive them, they know not what they do;" since for them the harvest will be poor in flowers and fruit, and rich in weeds and thorns.

What are the facilities in the United States for sustaining a class of original investigators; a class whom many praise, but whom few think of as requiring unencumbered time for their work? In spite of the fact that this land was settled by idealists and thinkers in their way, we are behind the old world in the means and methods of making a life of scientific work even respectable. Professorships are mostly encumbered with work. Positions for pure research are very few. Of prizes, honorary and financial, we have scarcely any. The positions in the gift of our societies are nearly all to be obtained by political methods only, to which the true student is of necessity a stranger.

If there be no opportunities or rewards for the scientific specialist in this country, we will have to look abroad for the stimulus to thought, and for a sentiment to offset universal sordidness.

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RECENT LITERATURE.

THE CRUISE OF THE "ALICE MAY."[1]—When a yachtsman is a good story-teller and artist, and he sails through waters rich in historic and scenic features, and moreover when his publishers give him *carte blanche* to reproduce his sketches in a style unsurpassed, with the accessories of luxurious paper and presswork to correspond, the results can be safely predicted. The Gulf of St. Lawrence is a royal region for the explorer and tourist. Ever since its discovery by Jacques Cartier, and probably before his time, Basques, Bretons, Englishmen and Spaniards have fished in its waters, and hunted walrus on its islands; while antiquarians, geologists and naturalists have in later times explored every recess. The bold shores of Nova Scotia, the naked coast of Newfoundland recalling the bare coast of Spain; the low red shores of Prince Edwards island, the lonely isolated cliffs of Bird rocks and the sullen, frowning crags of the Labrador coast—what variety, what adventure, what rich gleanings in all fields of healthful sport and science await the summer cruiser in this grand gulf! And now comes the artist who crowns the whole with a series of pictures of life and nature on the shore and wave. With what

[1] *The Cruise of the Alice May in the Gulf of St. Lawrence and adjacent waters.* With numerous illustrations. Reprinted from *The Century* magazine. By S. G. W. BENJAMIN. New York, D. Appleton & Co., 1885. Sm. 4to, pp.

success Mr. Benjamin has rendered two of the grandest scenes may be seen by a glance at the two plates, for copies of which we are indebted to the publishers of *The Century* magazine.

Chartering a schooner at Prince Edwards island, Mr. Benjamin and his party sailed up the mouth of the Miramichi river, thence to Bay of Chaleur, thence north to Cape Gaspé, then visiting the Magdalen islands he crossed the Newfoundland coast, ascending the Humber river. He then visited the Island of St. Pierre on the southern coast of Newfoundland, finally crossing over to Cape Breton and taking the inside passage through the Little and Great Bradore lake; then passing through the Gut of Canso, the party left their schooner, the voyage completed, at Georgetown, P. E. I.

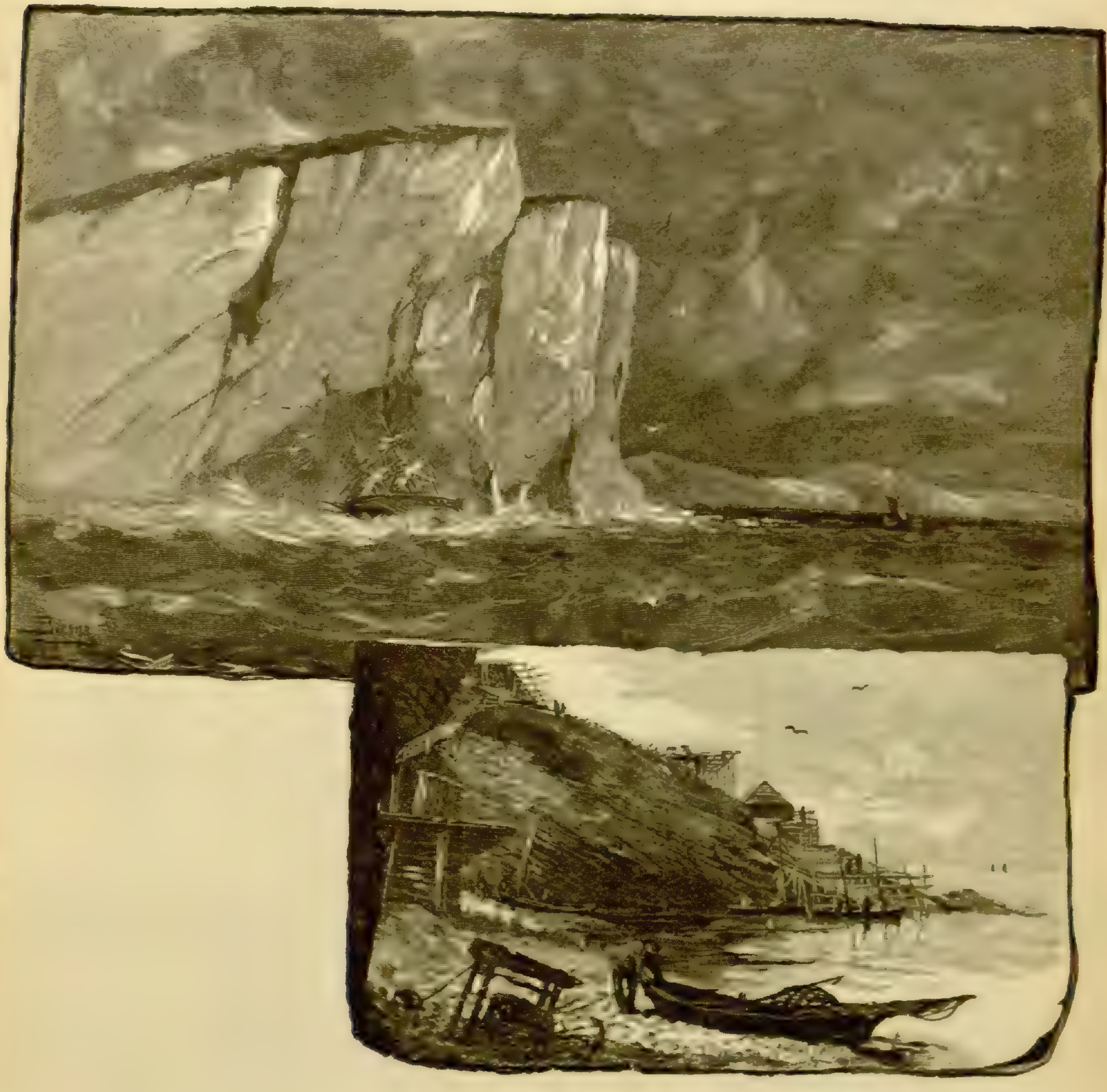
Our naturalist readers will be interested not only in the descriptions of the scenery, but also in the accounts of the fisheries and particularly the squid fishing as carried on at the Miquelon island. Mention is made of a peculiar breed of dogs at Arichat, Cape Breton. "They are," says our author, "like Newfoundland dogs, large, black and shaggy, but some waggish fate has robbed them of their tails, leaving only a shortish stump." The breed is said to be peculiar to Arichat, and we wish it had been ascertained through how many generations it has been in existence.

A good many tourists will want to follow more or less closely the wake of the *Alice May*, and will be compelled to take with them as a guide book this breezy, richly illustrated narrative of the cruise.

IRVING'S COPPER-BEARING ROCKS OF LAKE SUPERIOR.[1]—This volume is an elaborate account of a series of rocks whose age and relations have been much in dispute. The subject is treated largely from the lithological standpoint, and is richly illustrated by colored plates of microscopical sections and by elaborate geological maps. Professor Irving adopts the view published in the third volume of the Geology of Wisconsin in 1880 as to the pre-Cambrian age of the copper-bearing rocks, "which are in Northern Wisconsin found to be separated from the basal fossiliferous Cambrian sandstone of the Mississippi valley by a great supervening erosion, while from the underlying Huronian the separation did not appear to be so great." In that report these rocks were described under the name of the Keweenaw or Keweenawan series, following the previous suggestions of Hunt and Brooks, and this term is adopted by Professor Irving.

The report appears to have been prepared with care and ability, and is a most important contribution to theoretical as well as economic geology.

[1] *U. S. Geological Survey.* C. King, director. The Copper-bearing rocks of Lake Superior. By ROLAND D. IRVING. Washington, D. C., 1883. 4to, pp. 464.



Cape Gaspé.

Fishing-houses at Cape Gaspé.

THE MICROSCOPE IN BOTANY.[1]—This edition and translation differs in many important respects from the original, having been especially adapted by the American editors to the wants of botanical students in this country. The changes are most numerous in chapter I, which is devoted to a discussion of the microscope. Here the student will find much valuable and interesting matter. We cannot refrain from quoting, for the benefit of our makers of microscopes as well as the younger botanists, the remark of Hugo Von Mohl: "The simpler the construction of the microscope is, the more easily and more quickly will one accomplish all the necessary movements. The more complicated the construction the more will they cost in time and reflection, and the more will the attention be distracted thereby during the observation. Whoever has not the manual dexterity to work with a simply constructed microscope, and finds it necessary to use a screw instead of his fingers for every movement, is on that account disqualified for a microscopical observer, for he will labor in vain to prepare a usable specimen" (p. 8).

The second chapter is devoted to accessories, and the third to the preparation of microscopic objects, both of which pertain to microscopy in general fully as much as to micro-botany.

Chapter IV is devoted to the reagents to be used in the botanical laboratory. The treatment here is satisfactory, and reminds one much of Poulson's Botanical Micro-Chemistry.

In chapter V we find the book proper, to which all the preceding chapters have been accessory and preparatory. Here are taken up the various substances to be found in the plant, *e. g.*, cellulose, including wood and cork, starch, dextrine, mucilage, gum, inulin, sugar, albuminous matter, chlorophyll, the coloring matter of flowers, etc., etc. In all this portion of the book the treatment is such that the student cannot fail to obtain many useful suggestions and hints in his work.—*Charles E. Bessey.*

THE AMATEUR NATURALIST, Germanton, Phila.; THE HOOSIER MINERALOGIST AND ARCHÆOLOGIST, Indianapolis; THE MUSEUM, Philada.; THE YOUNG MINERALOGIST AND ANTIQUARIAN, Wheaton, Illinois.—These periodicals are intended for the instruction and pleasure of the younger naturalists, and we welcome them as a useful agent in developing the taste for science which is so frequently seen among boys. Such publications serve to keep alive an interest which is often more or less extinguished with advancing years and responsibilities, but which is of much value to the possessor. A more general adoption of the scientific or positive method in thought and action is one of the anticipations of those

[1] *The Microscope in Botany.* A guide for the microscopical investigation of vegetable substance. From the German of Dr. Julius Wilhelm Behrens. Translated and edited by Rev. A. B. HERVEY, A.M., assisted by R. H. WARD, M.D., F.R.M.S. Illustrated with 13 plates and 153 cuts. Boston, S. E. Cassino & Company. 1885, pp. xvi, 466. $5.

that believe in progress; and these scientific journals for the young are one of the agencies by which this state of things is to be brought about.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*The Sahara.*—Dr. Oscar Lenz has published his work on "Timbuktu" and is preparing to set out on a new expedition. His exploration of 1879–80 comprised (1) Marocco and the Atlas ranges as far as the Draa basin, and (2) the Western Sahara. Dr. Lenz traveled with only two interpreters and a trusty Maroccan attendant, yet thanks to a letter of recommendation from the Sultan of Marocco, and his assumption of the character of a Mussulman physician, he passed safely through the fanatical tribes on the route. The stony and sandy tracts of the Western Sahara are produced by the weathering of sandstone, quartz and carboniferous limestones, and have a mean elevation of from 800 to 1000 feet. Dried-up watercourses, with deep eroded channels, radiate from the central highlands north and north-east to the Mediterranean, east to the Nile, south to the Tsad and Niger, and west to the Atlantic. The conclusion seems to be that up to comparatively recent times the Sahara was a well-watered and wooded region, mostly inhabited by pastoral and agricultural communities, the descendants of more primitive peoples who were contemporary with Palæolithic and Neolithic man elsewhere. In the Taudeni district, about 20° N., under the meridian of Timbuktu, Dr. Lenz found some well-worked greenstone implements. Gerhard Rohlfs has found similar objects as far east as the Kufara oasis south of Tripoli. The Asiatic camel is a comparatively recent intruder. The crocodile still survives in many of the pools and lakelets which here and there mark the course of mighty streams. Dr. Lenz believes the desiccation to have taken place during the historic period, and attributes it largely to the reckless destruction of the woodlands. As vegetation disappeared so did moisture, the large fauna became extinct, and the settled populations were succeeded by nomad Berbers and Semites. The fortifications of Timbuktu were razed upon its capture by the Fulahs in 1826, and since then it has been a purely commercial town, but a constant bone of contention between the Tuariks and the Fulahs, which levy dues but leave the administration in the hands of the Kahia. Dr. Lenz affiliates the Fulahs to the Nubas, but A. H. Keane, in his review of the work, in *Nature*, considers this an error. The Fulahs are distinctly non-Negro, and Dr. Lenz notices the resemblance to Europeans of full-blood specimens.

M. Giraud's Expedition.—M. V. Giraud, in his account of two years among the Central African lakes, delivered before the Geo-

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

graphical Society of Paris, states that his strongest impression is the state of extreme misery in which the natives live, a misery due partly to their own laziness, but partly to the sterility of the soil. The harvest is in June, but in three months the crop is consumed, and during the rest of the year they live on wild honey, roots, fungi and wild fruits. At this season the paths are strewn with corpses. M. Giraud believes that the population is always decreasing. The only two metals found were iron and copper. It must be remembered that M. Giraud had a most discouraging experience.

Recent Acquisitions of Spain.—Spain has recently acquired considerable territory in Africa, comprising the west coast of the Sahara between Cape Bogador (20° 9′ N.) and Cape Blanco (20° 45′ N.), both included; and in the Gulf of Guinea the coast line from the Muni river, which forms the northern boundary of the French possessions on the Gaboon, to the Rio Campo (0° 43′ to 2° 41′ N.). Six stations have already been established on the Sahara coast, and all points giving access to shipping will be permanently occupied. Old treaties with the chiefs on the Rio Benito have been renewed, with a view to prevent the threatened advance of the French in that direction.

The Kingdom of the Congo.—The limits of the new "Kingdom of the Congo," as recognized by the late Berlin conference, appear to be as follows: On the Atlantic seaboard from Banana point to Yabé (5° 45′ S. lat.), then by one parallel of Yabé to the meridian of Ponta da Lenha, by this meridian north to the Chiloango, then to the source of that river, thence to the Mtombo-Mataca falls of the Congo, leaving to the French the station of Mboco, but reserving Mucumbi and Manyanga, then along the Congo to its confluence with the Bumba beyond the equator, where the boundary running north-west remains to be determined. The southern frontier follows the Congo from Banana to a point a little above Nokki, the south bank belonging to Portugal, then on the parallel of Nokki to the Qwango, along this river to about 9° S. lat., and thence in a diagonal line across the continent to Lake Bangweolo. Eastwards the boundary coincides with the west coasts of lakes Bangweolo, Tanganyika, Muta-Nzighe and Albert Nyanza. Within these limits the new State will have an approximate area of 1,000,000 square miles and a population of probably 40,000,000, mostly of Bantu speech and Negro or Negroid stock.

The Red Sea Coast.—Sir R. W. Rawson (Proc. Roy. Geog. Soc., Feb., 1885) contributes a long and learned article upon "European Territorial claims on the coast of the Red sea and its southern approaches." Many facts in the history of Abyssinia are given, and the grounds of the various claims discussed. The truncated triangle of lowland between Abyssinia and the Red sea

does not seem to have ever been practically in the hands of Abyssinia, and the rule of Turkey and Egypt has been nominal. According to the "Geographie Universelle," of Reclus, the area of this tract is about 54,000 square miles, and its population about 300,000. It is practically a desert, and its inhabitants are the nomad Danakil and other similar tribes. There is very little water, the chief river being the Hawash, which runs into lake Aussa, and then forms a brackish lake called Abhebad, about sixty-five miles from Tajura. The stream issuing from this lake fails to reach the sea, and terminates thirty-six miles from Tajura. Obock, the French possession outside the straits of Bab-el-Mandeb, has sixty-two miles of coast, and an area of 1470 square miles. It has not as yet any attraction for settlers, since it is without water, cattle, or vegetables. The first can, however, be procured from the Hawash basin, and cattle can be brought from Somali-land. The real drawbacks are the situation and character of the harbor and its position fifty or sixty miles from the route to India and the East. Sagallo, thirty-seven miles from Obock, has also been ceded to France by the local sultan. This place lies on the road from Ankober, the capital of Shoa, to Tajura, the chief place of export of King Menelik's country. King Menelik, according to M. Bramond, dreams of railroads through his dominions, and of steamers on the Hawash to Lake Aussa.

The territory of Assab, now in the hands of Italy, includes the bay of that name, with all its islands and the coast line from Ras Darmah, the eastern point of the Bay of Beilul, in N. lat. 13° 14′ to Ras Sintiyar, the south-east point of the Bay of Assab, in N. lat. 12° 53′. The belt of territory purchased from the local sultans by Italy is from two to six miles wide and thirty-five miles long.

African News.—From the remarks of Mr. J. M. Cook, who has recently returned from Dongola, it appears that the cataracts of the Nile are not correctly placed upon the map. The so-called third cataract at Hannek is no cataract at all, only a very small rapid. Between the second and so-called third cataracts four or five cataracts occur, and these explain the delay in the concentration of the British troops at Dongola. From Sarras to Sakarmatta (seventy-four miles), the rise was 450 feet.——A fresh expedition in Somali-land has been undertaken by Messrs. F. L. and W. D. James, who writes from Berbera that they intend to traverse the Habr Gerhajiš's country to Lebiholii, whence five days over the desert will bring them to Ogaden. They have a guard of seventeen Somalis collected at Aden.——The map of Africa, on a scale of twenty-seven geographical miles to the inch, in course of publication by the *Depôt de la Guerre*, will consist of sixty sheets. Twenty-four of these have been published, eighteen of West and Central Africa, six of South Africa and Cape Colony. Sheet 9 shows the Canaries and the sterile country called by Dr. Barth "Tiris el Ferar,"

or the country of deep wells; sheet No. 10 gives the western half of the Sahara, and shows the routes of travelers, with many notes on the inhabitants, nature of the country, and position of the oases and wells and sheet No. 11 has a portion of the Ahaggar region, of which little is really known, and the better known Tuat oasis——M. Giraud has finally been compelled to desist from his attempted explorations. His men deserted him, retaining the French flag and Chassepôt rifles, and turned highwaymen on their way back to Zanzibar, where they were cast into prison by the French consul.——Major Serpa Pinto is at Mjuani, on the shores of the fine harbor of Nakala, which extends inward from Fernão Veloso bay.——M. F. S. Arnot has sent to the Royal Geographical Society a sketch-map of his route from Shoshong to Bihé. He followed the Zambesi, from his point of crossing, a little above Victoria falls to Lialui, from which he proceeded west-north-west to the great plateau on which Bihé is situated.—— Petermann's Mittheilungen (31 Band, 1885, III) contains a map of Zululand and the gold fields of the South African republic, with a description: The previous issue gives a chart of Stella-land.

GEOLOGY AND PALÆONTOLOGY.

Sir William Dawson on the Mesozoic Floras of the Rocky Mountain region of Canada.[1]—In a previous memoir, published in the Transactions of the Royal Society of Canada, Vol. I, the author had noticed a Lower Cretaceous flora consisting wholly of pines and cycads, occurring in the Queen Charlotte islands, and had described a dicotyledonous flora of Middle Cretaceous age from the country adjacent to the Peace river, and also the rich Upper Cretaceous flora of the coal formation of Vancouver's island—comparing these with the flora of the Laramie series of the Northwest Territory, which he believed to constitute a transition group connecting the Upper Cretaceous with the Eocene Tertiary.

The present paper referred more particularly to a remarkable Jurasso-cretaceous flora recently discovered by Dr. G. M. Dawson in the Rocky mountains, and to intermediate groups of plants between this and the Middle Cretaceous, serving to extend greatly our knowledge of the Lower Cretaceous flora, and to render more complete the series of plants between this and the Laramie.

The oldest of these floras is found in beds which it is proposed to call the Kootanie group, from a tribe of Indians of that name who hunted over that part of the Rocky mountains between the 49th and 52d parallels. Plants of this age have been found on the branches of the Old Man river, on the Martin creek, at Coal

[1] Read before the Royal Society of Canada, May, 1885.

creek, and at one locality far to the north-west on the Suskwa river. The containing rocks are sandstones, shales and conglomerates, with seams of coal, in some places anthracitic. They may be traced for 130 miles in a north and south direction, and form troughs included in the Palæozoic formations of the mountains. The plants found are conifers, cycads and ferns, the cycads being especially abundant and belonging to the genera Dioonites, Zamites, Podozamites and Anomozamites. Some of these cycadaceous plants, as well as of the conifers, are identical with species described by Heer from the Jurassic of Siberia, while others occur in the Lower Cretaceous of Greenland. The almost world-wide *Podozamites lanceolatus* is very characteristic, and there are leaves of *Salisburya sibirica*, a Siberian Mesozoic species, and branches of *Sequoia smittiana*, a species characteristic of the Lower Cretaceous of Greenland. No dicotyledonous leaves have been found in these beds, whose plants connect in a remarkable way the extinct floras of Asia and America and those of the Jurassic and Cretaceous periods.

Above these are beds which, with some of the previous species, contain a few dicotyledonous leaves, which may be provisionally referred to the genera Sterculia and Laurus; and still higher the formation abounds in remains of dicotyledonous plants of which additional collections have been made by Mr. T. C. Weston. The beds containing these, though probably divisible into two groups, may be named the Mill Creek series, and are approximately on the horizon of the Dakota group of the United States geologists, as illustrated by Lesquereux and others. The species are described in the paper, and differ for the most part from those of the Dunnegan group of the Peace river series, which is probably of the age of the Niobrara group, and, of course, still more from the overlying Laramie group. With regard to the latter, the author adduced some new facts confirmatory of his previously expressed view as to the position of the Laramie at the top of the Cretaceous and base of the Eocene, and also tending to show that some of the plants still held by certain palæo-botanists to be of Miocene age are really, in Canada at least, fossils of the Laramie group, and consequently considerably older than is currently supposed. The collections of plants studied by the author had, for the most part, been placed at his disposal by the director of the Geological Survey.

THE SYNCARIDA, A GROUP OF CARBONIFEROUS CRUSTACEA.—The following are the conclusions of a paper read at the last meeting of the National Academy of Sciences. The genus Acanthotelson of Meek and Worthen was by them doubtfully referred to the Isopoda though stated to bear some resemblance to the lower Decapoda. After describing the fossils from specimens kindly loaned by Messrs. R. D. Lacoe and J. C. Carr, we arrived at the

following results of a reinvestigation of the characteristics of the genus:

What we should regard as the differential characters of the group Syncarida, to which Acanthotelson belongs, are the sixteen free segments of the body which are homonomous or of uniform size; the first and second, however, being soldered together and forming the head; the absence of a true carapace; the seven pairs of schizopod-like legs, the first pair spined and raptorial, slightly reminding one of those of Squilla; the antennæ of both pairs being long and slender, the two flagella of the first pair being very unlike any sessile-eyed or edriopthalmatous crustacean; the six pairs of abdominal feet, which are long, slender and with a general resemblance to those of the Schizopoda; the broader, oar-like, swimming ramus ending in long setæ. Any doubts as to the macruran affinities of the Syncaridæ are removed by an examination of the telson and the last pair of abdominal appendages, with the long acute telson; the appendages are biramous, the divisions flattened from above downwards, so that they, with the telson, serve as in schizopods and shrimps for propelling the body backwards when the animal is disturbed.

We should regard the Syncarida as the lowest group of Thoracostraca, but much nearer the Schizopoda than the Cumacea; they form a connecting link between the Amphipoda and Thoracostraca, but at the same time in their most essential characters are much nearer to the schizopods than the Amphipoda. The lack of a carapace, even a rudimentary one, and the homonomous segmentation cause them to bear a resemblance to the Edriopthalmata which they would not otherwise present.

To the Isopoda Acanthotelson presents a superficial resemblance, due to the slightly vertically-compressed body and the homonomous segmentation. The Edriopthalmata (Arthrostraca of some late authors) are defined by Claus as "Malacostraca with lateral sessile eyes, usually with seven, more rarely with six or fewer separate thoracic segments, and the same number of pairs of legs; without a carapace; but this does not express those differences in the form of the antennæ the thoracic legs and abdominal appendages especially those of the end of the urosome or abdomen, which are characteristic of the sessile-eyed Crustacea as distinguished from the Thoracostraca.

From the Isopoda in which the body is usually broad and vertically flattened, with seven free thoracic segments, while the abdominal legs are lamellar and closely appressed to the short abdomen, our Acanthotelson plainly differs in the long biflagellate decapod-like first antennæ; in the long homonomously ringed abdomen and schizopodal abdominal feet and especially the schizopod-like telson and last pair of feet, adapted as in the shrimps for striking the water from above downwards.

The Amphipoda are in general characterized by their laterally

compressed body with lamellate gills on the thoracic feet and an elongated abdomen, of which the three anterior segments bear the swimming feet, while the three posterior has posteriorly directed feet adapted for springing (Claus). Now if Acanthotelson is not an isopod, still less should it be regarded as related to the Amphipoda. The first antennæ are entirely unlike those of any known amphipod, in which there is a very short accessory flagellum; the second antennæ of Acanthotelson are strictly decapodous in appearance and very different from that of the Amphipoda, whereas in Gammarus the scape is as long as the flagellum. Although there are seven free thoracic segments in Acanthotelson as well as in Gammarus and other Amphipoda, those of Acanthotelson are not compressed any more than in the Schizopoda, and there are no traces of epimera; on the contrary the free edges of the thoracic and abdominal segments are much as in the Schizopoda and Caridea. The thoracic appendages of Acanthotelson are on the whole like those of the Stomapoda and Schizopoda. We cannot detect any traces of mouth parts, mandibles, with their palpus or maxillæ, etc., but the thoracic legs do not present any close resemblance to those of the Amphipoda, the first pair being as much if not more like those of Squilla than any amphipod with which we are acquainted, while the three posterior pairs which are in form and size like those in front, entirely differ from those of Gammarus and most other normal amphipods in which the basal joint is very large and triangular. Turning to the abdomen the differences of that of Acanthotelson from that of the amphipods is still more marked. The first five pairs of uropoda or abdominal appendages are in Acanthotelson all formed apparently on the same plan, not essentially different from those of schizopods, while the last pair are flat and on the same plane as the telson and intimately associated with the latter, in that these parts are formed on a truly macrurous plan and most approach those of the schizopods, in which the telson and rami of the last pair of feet are narrow and more or less acute at the end. There is nothing in the structure of the urosome and its uropoda in Acanthotelson to remind us of the same parts in the Amphipoda.

Excluded from the sessile-eyed Crustacea, and forced to place Acanthotelson in the Thoracostraca, we are confronted by the lack of a carapace, and the homonomous segmentation of the body. These are essential, fundamental characters, but still the nature of the appendages and telson is such as to forbid us from rejecting the Syncarida from the ordinal limits of the Thoracostraca. We are compelled to regard the group as a suborder standing near or at the base of the Thoracostraca, not far from the Stomapoda and Schizopoda, and with appendages closely homologous with those of these two groups. The Syncarida, in their lack of a carapace and in the well-formed dorsal arch of the seven thoracic segments, we are obliged to consider as

an annectant group, pointing to the existence of some extinct group which may have still more closely connected the sessile-eyed and stalk-eyed Crustacea.—*A. S. Packard.*

MARSH ON THE DINOCERATA.[1]— This work, which has been announced for some time, is now before us. It is one of the quarto series of the United States Geological Survey, but the present edition was published, we are informed, by the author at his own expense. The mechanical execution of the book is good, and it will remain a monument to its authors. We confess, however, to surprise at not finding it, as we had anticipated, a monograph of the group. According to the synopsis of twenty-nine reputed species, which forms the last part of the volume, a great deal of material representing them has been obtained by Professor Marsh, but we have searched in vain for a description of the greater part of it in the work. The memoir is in fact of a rather general character, giving descriptions of the osteology of the two species *Loxolophodon mirabile* and *L. ingens*,[2] with occasional references to others. It is evident that the greater part of the work of writing this monograph remains to be done. We should have preferred to have seen this magnificent opportunity improved, so that it should have embraced detailed descriptions of those characters of all the species on which alone the derivation theory can be established or refuted. A natural result of this neglect is a failure to appreciate the true generic relationships of the species. There are no sufficient characters adduced for the generic discrimination of the species included under the heads Dinoceras and Tinoceras, while the characters of Uintatherium are erroneously given. The distinct genus Bathyopsis is not admitted, and there are two distinct genera, represented by species described by Professor Marsh, which are not recognized.[2]

Professor Marsh thinks that the females of these animals had shorter canine teeth than the males, and that the protective mandibular flange is correspondingly small in that sex. He also finds variation in the nasal tuberosities, and indicates that these also are larger in male animals.

In connection with the description of the brain of the Dinocerata, Professor Marsh gives us much new valuable information as to the brain characters of a number of extinct ungulates. He, however, fails to give Professor Lartet credit for the proposal of the general theory of brain development in the Mammalia with the progress of geological time.

The classification of the Ungulata adopted is largely that of Cope, to whom no acknowledgment is made. A hypothetical group is proposed and defined as the primitive type of Ungulata.

[1] The Dinocerata. By O. C. Marsh.

[2] For the genera of Dinocerata, see NATURALIST, June, 1885.

Professor Marsh is apparently not aware that this group has been actually discovered, defined and extensively illustrated under the name of Condylarthra by Cope, and that its discovery was anticipated on hypothetical grounds by the same author as long ago as 1874.[1] The unwary reader may be still further impressed with the idea that all this is new, by the array of new names which are attached to these well-known natural divisions. The Condylarthra figure under another name, and those of Amblypoda and Pantodonta are changed on the pretext that they are preoccupied, though Professor Marsh does not state when or how. Careful examination has failed to reveal any real preoccupation. The nearest name to Pantodonta is Pantodon, a genus of fishes, and to Amblypoda is Amblypodia, an unused synonyme in Lepidoptera. We do not believe, however, even were the names identical, that a generic name can be preoccupied by the name of an order, or other mononomial word, or *vice versa*. The name Diplarthra (the Ungulata of Gill and Flower) is changed for a new one, and other terms are employed for the time-honored and generally used Perissodactyla and Artiodactyla of Owen. We forbear comments, remarking only that even a handsome volume like this one will not suffice to obliterate history.[2]

On p. 169, one is surprised to read the following statement: "No Cretaceous mammals are known." Two species were described from the Laramie Beds of Dakota, two or three years ago.

Professor Marsh corrects by implication a good many errors made by himself several years ago when criticising the work of another author on this group. Thus he adopts the species *Loxolophodon cornutus* Cope, and no longer considers it identical with a species subsequently described by himself. But he cannot avoid making a misrepresentation as to a photograph of this species of which a few copies were circulated at the time of its discovery. The statement that the canine tooth was attached to the skull by a plaster base so as to increase its apparent length is erroneous. The tooth was made to adhere to its base by a piece of paper which took white in the picture, and which Professor Marsh takes for granted was plaster. The reproduction of this photograph in Professor Marsh's book instead of some of the good figures which have since appeared, is apparently designed to substantiate this statement. Professor Marsh, moreover, does not recede from the erroneous position he took at that time on the question of nomenclature, but still uses generic names which have been repeatedly shown to have no right to exist if the ordi-

[1] Journal of the Academy of Natural Sciences Philada. Proceedings do, 1873, Nov. 13th.

[2] See AMERICAN NATURALIST for Nov. and Dec., 1884, and Jan., 1885, on the Amblypoda.

nary rules of nomenclature are observed.[1] The history of the subject is concealed from the reader by the omission of reference in their proper places to the papers which antedate those of Professor Marsh, and by the omission of the dates of their publication when they are referred to.[2]

This work will always be valuable for the descriptions and plates which it contains, and with the abatements we have already pointed out, we recommend it as the handsomest work on the subject yet published.—*E. D. Cope.*

Geological News.—*General.*—From a paper recently read by W. H. Hudleston at the meeting of the Geologists' Association it appears that the "Nubian sandstone" comprises the strata between the crystalline rocks and the Upper Cretaceous; the lower sandstone and overlying limestone of Wady Nasb is Carboniferous; the middle division is Cenomanian, is widely extended in Egypt, occurs in great force at Petra, and constitutes the cliffs on the east side of the Dead sea; while the Lebanon division is probably well up among the Cretaceous limestones and possibly on the horizon of certain ligniferous beds occurring at Edfou on the Nile. The crystalline rocks are in two series, a lower (referred to the Laurentian) penetrated by dykes of granite and diorite; and a second series consisting mainly of porphyries permeated by dykes of feldspar and basalt. All the Nile cataracts occur where the river passes over such crystalline areas, while the tranquil stretches are upon the Nubian sandstone. The Cretaceous limestones are in Syria more important than those of Eocene age, but in Egypt the latter are much the thickest. The Cretaceous beds in Egypt are much less calcareous than those of Palestine, and abundance of rocksalt, gypsum and bitumen is noted on certain horizons (Zittel). Neither in Palestine nor in Egypt is there any sharp line of demarkation between the chalk and the Tertiary rocks. The celebrated Jebel Usdom or Salt mountain of the Red sea, is assigned to the Cretaceous by Dr. Lartet, but to the marls of the Dead Sea basin by Hull. Zittel states that the palæontological boundary between the chalk and the Eocene is clearly defined, despite the continuity of the marine deposits. The Dead sea hollow is undoubtedly an independent lake basin of high

[1] We take the present opportunity to refer to some similar cases of hypersensitiveness to be found in Professor Marsh's papers on the Dinosauria. The genus Megadactylus was named by Dr. Hitchcock, in 1865, from specimens from the Trias of Connecticut, but was not defined. It was defined by Cope in 1870. Professor Marsh changes the name because it had already been used by Fitzinger for a genus of lizards. But Fizinger's name is an undoubted synonyme of a well-known form, and has no status whatever. We hold that the change of name is unwarranted. The name Lælaps is also discarded for another, because the name Lelaps is used for a genus of Hymenoptera. The names are not identical, and there is no preoccupation. On the same principle Dinoceras should give way to Tinoceras of earlier date, as they differ by but a single letter, were not both names really synonymes of a still older one.

[2] See the Bibliography, p. 225.

antiquity. The watershed separating it from the southern portion of the Arabah is 660 feet high, while the highest point of the Vale of Jezreel is only 285 feet. Marl deposits exist in the Dead sea basin at an elevation of 1400 feet above the present Dead sea level, and the old marls of the Jordanic lakes are not entirely unfossiliferous, as three Melanidæ have been found in them.

Silurian.—Figures of the now celebrated fossil scorpions found in the Silurian rocks of Scotland and Gothland by Dr. Hunter and Professor Lindstrom, are given in *Nature* (Jan. 29), and Mr. B. N. Peach gives in the same number a compendium of our knowledge of these ancient air-breathers. The first Paleozoic scorpion found was described in 1835, by Count Sternberg, from a specimen obtained in the coal formation of Chonile, near Radnitz, in Bohemia. Three years later Corda described another (Microlabis) from the same locality. In 1866 Messrs. Meek and Worthen described two new species from the Coal Measures of Mazon creek, Illinois. In 1873, Dr. H. Woodward showed that the genus Eoscorpius (one of those found at Mazon creek) occurs in the English Coal Measures and in the Carboniferous limestone of Scotland. In 1881 Mr. Peach examined a large series of scorpions from the lowest Carboniferous of the Scotch border, and described (Trans. Edinb. Roy. Soc.) several species of Eoscorpius, with the remark that Meek and Worthen's name was unfortunate, since the dawn of the scorpion family must have been much earlier. Although Dr. Hunter's specimen was the last announced, it was obtained a year before the discovery of the Gothland specimen. It agrees with the latter (*Palæophonus nuncius*) in having pointed thoracic feet, unlike those of Carboniferous times and of the present age. Mr. Peach asks, What were the victims of these ancient murderers? The dragon-flies of the Middle Devonian of New Brunswick were thought to be the oldest land animals until Mr. Peach, in 1882, showed that chilognathous myriapods were far from uncommon in the Lower Old Red Sandstone of Forfarshire, in Scotland. There is but a short step from this to the Silurian, and M. Brongniart has found in the Silurian limestone of Calvados a fossil Blatta. Perhaps a habit of feeding on the eggs of animals left bare by the tides may account for the embedding of these air-breathers in marine strata.

Devonian.—*Hystricrinus carpenteri*, a crinoid with articulating spines, is described by G. J. Hinde in the *Ann. and Mag. Nat. Hist.*, March, 1885. The genus is identical with Arthrocanthus (Williams), a name preoccupied among the Rotatoria. Apart from the possession of articulating spines it is near Hexacrinus. The specimens are from calcareous shales of Middle Devonian at Arkona, Ontario. It is curious that in three out of the eleven examples a shell of the genus Platyceras is attached to the vault of the crinoid.

Cambrian.—Mr. Chas. D. Walcott (*Amer. Jour. of Science*, April, 1885) describes Mesonacis, a new genus of Cambrian trilobites, intermediate between Paradoxides and Olenellus, the head and first fourteen segments being of the type of the latter, while the pygidium and ten posterior segments more resemble the former. The fifteenth segment fits snugly against the fourteenth, and has a long, slender spine extending to the pygidium. *Mesonacis vermontana* occurs in the Georgian of the State it is named after.

Carboniferous.—MM. Renault and Zeiller have described a number of mosses from the carboniferous strata of Commentry (France). The mosses previously found in a fossil state have been few, and of the Tertiary epoch, principally Miocene, but the Commentry beds contain many impressions of their stems, three or four centimeters long, some simple, others with alternate fronds. The stems are usually united in tufts. The absence of any trace of the organs of fructification prevents the determination of the place of these fossils in present classifications, but MM. Renault and Zeiller think they belong rather among the acrocarps than among the pleurocarps.——T. R. Jones and J. W. Kirkby give, in the *Ann. and Mag. of Nat. Hist.* for March, a synopsis of the species of the ostracodous genus Kirkbya, eleven in number. Most of the specimens are from marine shales associated with the calcareous beds of the Carboniferous series.

Tertiary.—Mr. J. W. Judd has shown that in the Western isles of Scotland there occur a number of peridotite rocks which are the central cones of Tertiary volcanoes of vast dimensions. These Tertiary peridotites are intimately associated with the gabbros and dolerites, and present numerous variations both in structure and mineralogical constitution. Among them occur examples of the rocks which have received the names of dunite, picrite and lherzolite.——Dr. C. J. Forsyth Major (Quart. Jour. Geol. Soc., 1885) gives a list of thirty-nine species of fossil Mammalia found in the Val d'Arno. Not one of the members of the rich fauna found in the Mediterranean region and as far east as the Siwaliks of India, and existing on the boundary line between the Miocene and Pliocene, is found in the Val d'Arno, though the two antelopes, the Machairodus and the Mastodon, are closely allied. This Mediterranean fauna occurs at Casino, near Siena, and the somewhat younger fauna of the Val d'Arno was also spread as far as India. The shore deposits of the Pliocene sea in Italy are said by Dr. Major to contain the same mammalian fauna as the lacustrine deposits of the Val d'Arno. The Post-pliocene fauna exhibits several connecting links with the Pliocene, but, in Italy at least, not a single species of the older fauna seems to have gone over, as such, to the younger fauna. Not a single species of the thirty-nine is identical with those living to-day, and five

genera—Machærodus, Mastodon, Leptobos, Palæoryx and Palæoreas—are extinct. Pliocene mammals, but little altered, yet occur in the Sunda islands; the Anoa is close to the Siwalik Hemibos, *Bos etruscus* is a Bibos, close to the Banting of Java, the Pliocene stags, tapirs and rhinoceroses are nearly repeated by the forms now living in Southeastern Asia, and *Sus verrucosus* of Java is close to the Pliocene *Sus giganteus*. Professor Boyd Dawkins believes that two of the deer of the Pliocene of the Val d'Arno, as also the Hippopotamus, are identical with existing species.——A before unknown deposit of Pliocene age at St. Erth's, near the Land's End, Cornwall, has yielded fifty species of mollusks, of which all but eleven or twelve are extinct.

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.— 1st. *Bertrandite.*—This mineral, mentioned by Bertrand in 1880 (Bul. soc. min. d. Fr., III, 96) as a probably new aluminum-silicate from Barbin, near Nantes, is shown by Damour[2] to have the composition $4BeO, 2SiO_2, H_2O$, on which account he proposes for it the above name. It occurs in druses of a coarse pegmatite. Its system of crystallization is orthorhombic; axial ratio $a : b : c = 0.5619 : 1 : 0.5871$. Observed planes oP, ∞P, $\infty P\overline{\infty}$, $\infty P\breve{3}$, $\infty P\overset{v}{\infty}$, $\infty P\breve{3}$, $P\overset{v}{\infty}$, $3P\overset{v}{\infty}$. Plane of the optical axes is $\infty P\overset{v}{\infty}$. Principal bisectrix is ă. Dispersion $\rho < v$.[2]

2d. *Evigtokite* is a name applied by Flight[4] to a mineral of the cryolite group from Greenland having the composition CaF_2, AlF_3, H_2O. It is composed of masses of minute, white, transparent crystals.

3d. *Liskeardite* of the same writer occurs in layers sometimes a quarter of an inch thick, at the mines of Cornwall. It is fibrous in structure, of a white color or with a greenish or bluish tinge. Its composition is (Al, Fe) AsO_4, $8H_2O$. Analysis:

Fe_2O_3	Al_2O_3	As_2O_5	SO_3	CuO	CaO	H_2O
7.64	28.229	26.962	1.111	1.027	0.719	34.053

4th. *Pinnoite* is a new borate from Stassfurt described by H. Staute.[5] Its crystal form could not be determined. Sp. gr. 2.27. Hardness 3–4. Its composition is:

MgO	B_2O_3	H_2O	Fe	Cl
24.45	42.50	32.85	0.15	0.18

which gives the formula $MgB_2O_4 + 3H_2O$.

[1] Edited by Dr. Geo. H. Williams, of the Johns Hopkins University, Baltimore.

[2] Bull. soc. min. de Fr., VI, 1883, p. 252.

[3] Ib., p. 249.

[4] Journal Chem. Soc., Vol. 43, March, 1883, p. 140.

[5] Berichte der deutschen chemischen Gesellschaft, XVII, No. 12, p. 1584, July, 1884.

5th. *Avalite.*—S. M. Lasanitoch,[1] of Belgrade, gives this name to a new chromium-aluminium silicate occurring in thin green scales in the quartz of the quicksilver deposits at Avala, near Belgrade. An analysis of the purest specimen, which was, however, mixed with some chromite and sand, gave the following result:

SiO_2	Cr_2O_3	Al_2O_3	K_2O	Fe_2O_3	MgO	chromite	H_2O	loss
56.13	14.59	14.37	3.54	1.10	0.43	1.68	2.39	5.38

6th. *Zunyite.*—Mr. Hillebrand,[2] of the U. S. Geol. Survey, now stationed at Denver, Col., describes remarkable tetrahedral crystals of a new mineral which he found imbedded in an uncrystallized sulphide of lead and arsenic, occurring at the Zuñi mine on Anvil mountain, near Silverton, San Juan county, Col. These crystals are mostly very minute, rarely 5^{mm} in diameter. They show the forms $\frac{O}{2}$, $-\frac{O}{2}$, $\infty O \infty$ and ∞O or $\frac{mO}{2}$, and are quite isotropic. The smallest are clear and transparent; the larger ones dark on account of black inclusions. Sp. gr. 2.875 at 15° C. Luster glossy, cleavage octahedral, hardness 7. The mean of several analyses gave:

SiO_2	Fe_2O_3	Al_2O_3	K_2O	Na_2O	H_2O	P_2O_5	F	Cl
24.33	0.20	57.88	0.10	0.24	10.89	0.60	5.61	2.91

sum 102.76 — O for Cl and F (3.02) = 99.74.

Formula, $9R_2O$, $8Al_2O_3$, $6SiO_2$, with part of the O replaced by Cl and F. The black inclusions were shown to be titanic oxide.

7th. *Guitermanite.*—The metallic sulphide in which the above described crystals of zunyite were imbedded, was found to have the composition $10PbS$, $3As_2S_3$, being likewise a new mineral to which the same author applies the name Guitermanite.

8th. *Koninckite.*—M. Cesàro[3] has recently described a new hydrous phosphate of iron from Visé in Belgium. It occurs in spherical groups of radiating, nearly colorless monoclinic needles associated with richellite, another new mineral lately described by the same author (vid. NATURALIST, Jan., 1884, p. 65.) Koninckite has one perfect cleavage, H = 3.5; G = 2.3. Its composition is:

P_2O_5	Fe_2O_3	H_2O	Al_2O_3 (difference)	total
38.4	33.9	26.8	4.5	100

It is named after Professor De Koninck of Liége.

9th. *Endlichite or vanadium mimetite.*—Professor Genth[4] has found that certain straw-yellow crystals occurring at the silver mines of Southern New Mexico have the composition

[1] Berichte der deutschen chemischen Gesell., XVII, No. 13, p. 1774, Aug., 1884.
[2] Proceedings of the Colorado Scientific Society, Vol. I, 1883–84, p. 124.
[3] Mem. Soc. Geol. Belgique, XI, p. 247.
[4] Contributions from the Laboratory of the University of Pennsylvania, No. XXIII. Read before the American Philosophical Society, April 17, 1885.

Pb_5 Cl $(AsO_4)_3$ + Pb_5 Cl $(VO_4)_3$ or about equal proportions of vanadinite and mimetite. He has assigned to them the name Endlichite in honor of Dr. F. M. Endlich, superintendent of the Sierra mines at Lake valley, N. M. The same paper contains new analyses of vanadinite and a crystallographic investigation, by Professor G. vom Rath, of the New Mexican decloizite, illustrated by four figures. These crystals, which are the best ones thus far known, indicate that the mineral is orthorhombic, as was surmised by Des Cloizeaux instead of monoclinic as held by Websky. Associated with the vanadinite of Sierra Grande fine crystals of iodyrite were also found.

BOTANY.[1]

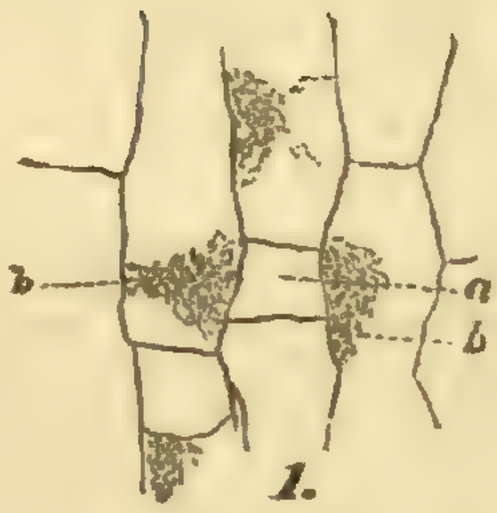
AMERICAN MEDICINAL PLANTS.—We recently noticed the first fascicle of this work, by Dr. Millspaugh, as worthy of patronage. An examination of the second fascicle confirms our favorable opinion. The illustrations are very good, and will not only serve admirably their purpose of enabling the medical student to recognize the various species of medicinal plants, but they will be found of value to the teacher or student of ordinary botany. In the second fascicle there are colored plates of *Actæa spicata*, *Carya alba*, *Cephalanthus occidentalis*, *Cypripedium pubescens*, *Equisetum hyemale*, *Juglans cinerea*, *Mitchella repens*, *Thuja occidentalis*, *Viola tricolor*, etc., etc., thirty in all.

DEVELOPMENT OF STOMATA OF THE OAT.—Before the stomata appear the epidermis is composed of quadrangular cells, which afterwards grow much faster in length than in breadth. The mother-cell of a stoma is cut off from the end of one of these cells, and sometimes each cell in a row furnishes a stoma (Fig. 1 *a*). This mother-cell rapidly increases in size, and large masses of protoplasm touching the cell soon become evident in the cells adjacent to the sides (Fig. 1 *b b*). This gathering of protoplasm is preparatory to the formation of accessory cells, which are at first nearly semicircular, and are cut out of the adjacent cells, one on each side of the mother-cell (Fig. 2 *b b*). The central and accessory cells now enlarge in about the same proportion until the former divides into two guard cells (Fig. 4); after this the accessory cells encroach upon the guard cells until in the mature stoma the latter are narrower through the center than at the ends; and the width of the whole four cells is but little more than of one single epidermal cell (Fig. 6).

The behavior of the protoplasm is very characteristic, the general rule is as follows: The mother-cell and the accessory cells are both at first full of rich protoplasm. In the accessory cells this tends to condense in the center; vacuoles first appear in the ends of the cells (Fig. 3), these increase in size with the develop-

[1] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

PLATE XXIII.



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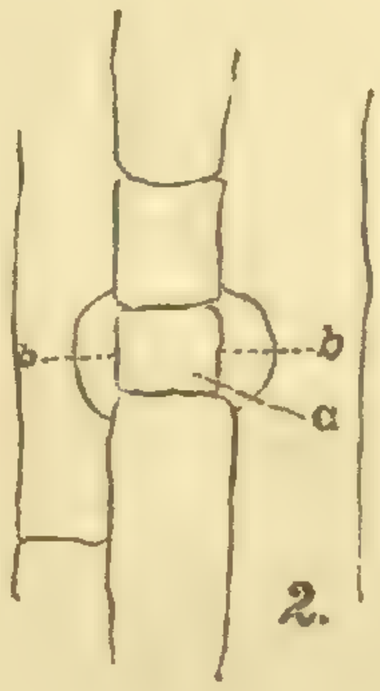

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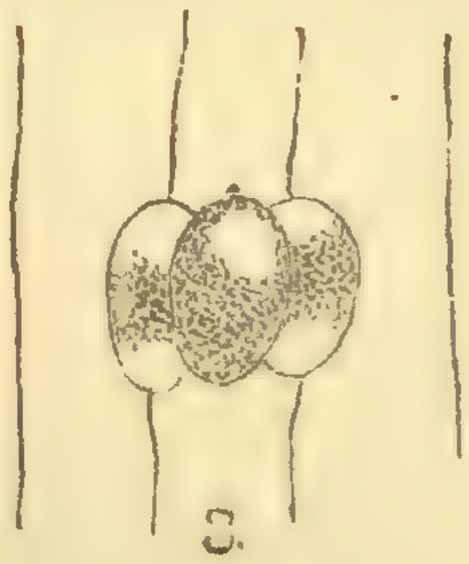
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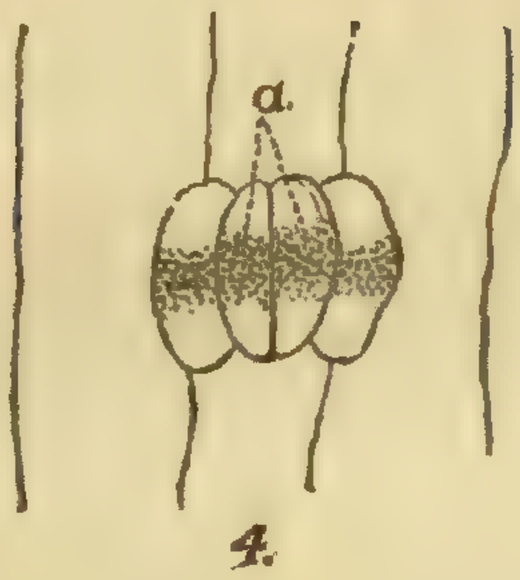

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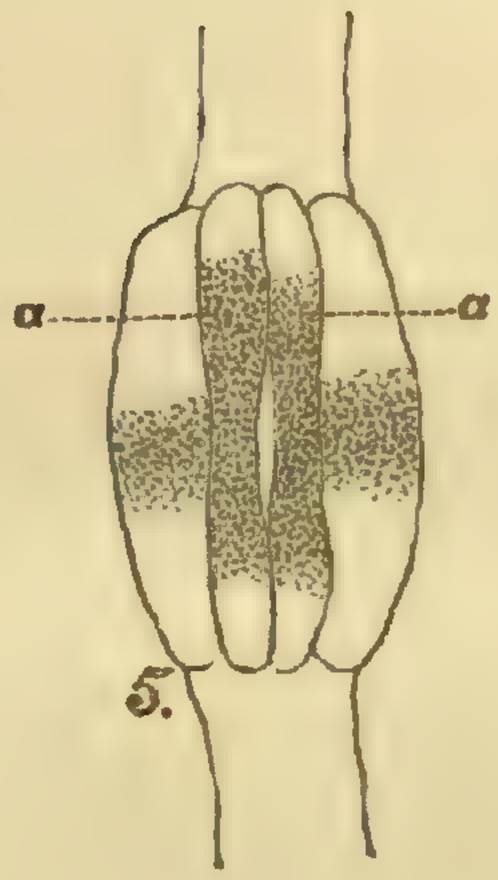

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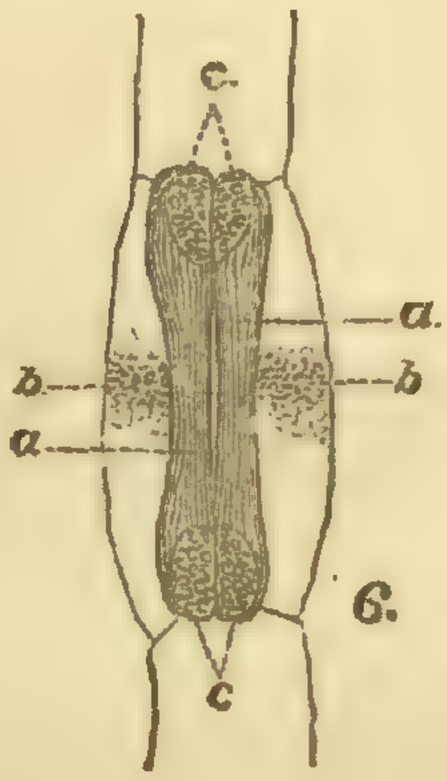

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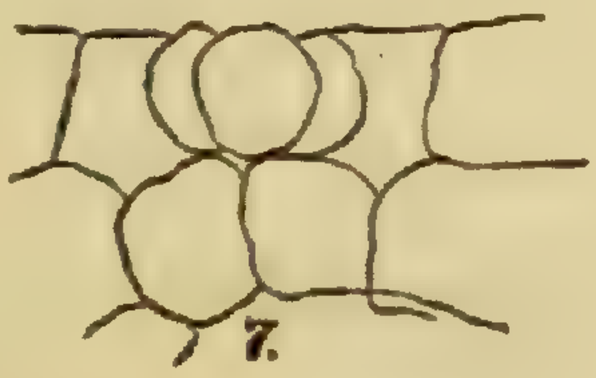

7.

8.

Stomata of the Oat.

ment of the stoma (Fig. 4), and in the mature stoma the visible protoplasm consists merely in a large nucleus in the center of each cell (Fig. 6 *b b*). In the mother-cell one or two vacuoles may appear in any place, one central vacuole is perhaps the most frequent form (Fig. 3), but when division takes place a band of thick protoplasm stretches across the center of the cell (Fig. 4 *a*). Instead of condensing this tends to extend through the length of the cells leaving vacuoles only in the extreme ends (Fig. 5 *a a*). In the immature stoma this protoplasm is very slightly granular and has a slight green tinge, as if chlorophyll is being formed (Fig. 5); but in the mature stoma it appears perfectly homogeneous, and small chlorophyll bodies which show the presence of starch on application of iodine, occupy the former vacuoles. A cross-section, made before the mother-cell has divided, shows very thin walls (Fig. 7), but a section of a mature stoma represents the guard cells as having thick walls, and I think it probable that most of the protoplasm has been absorbed in the thickening process (Fig. 8). This behavior of the protoplasm varies some in different stomata, especially in the stages represented in Figs. 3 and 4, but the process described prevails, and seems to be typical.

The methods of finding the different stages of development are very simple. If the leaves of a growing plant be unrolled until the youngest is reached and the base of this used, it will show the youngest forms. It is useless to attempt to remove the epidermis, for the leaves which would contain the undeveloped stomata are too tender to permit it. Soaking the young leaves in a two per cent salt solution for about ten minutes aids in showing the formation of the accessory cells, if an examination is made immediately.—*Effie A. Southworth, Bot. Lab. Univ. Mich.*

EXPLANATION OF PLATE XXIII.

× 425.

FIG. 1.—Mother-cell of stoma.

" 2.—Mother-cell and accessory cell.

" 3.—Same more advanced.

" 4.—Same with mother-cell divided into two guard cells.

" 5.—More developed stage of same.

" 6.—Mature stoma.

" 7.—Cross-section of a young stoma.

" 8.—Cross-section of a mature stoma.

THE OPENING OF THE FLOWERS OF DESMODIUM SESSILIFOLIUM.—This Desmodium, which grows abundantly in Central Iowa, presents a structural and physiological adaptation for securing pollination which is quite interesting. The purplish flowers are about 1.5 centimeters long and are arranged in pairs, racemosely upon a spreading terminal inflorescence. The keel is at first enclosed within the wings, which in turn enclose the stamens and

pistil. The standard projects forward approximately parallel with the other petals, diverging from them at a small angle (Fig. 1). The standard now begins to bend upwards and the wings and keel downwards, the resistance offered by the sepals being such as to cause the wings and keel with their contained stamens and pistil to be strongly deflexed (Fig. 2). The flower is now in a state of tension, and may be likened to a spring trap ready set for action.

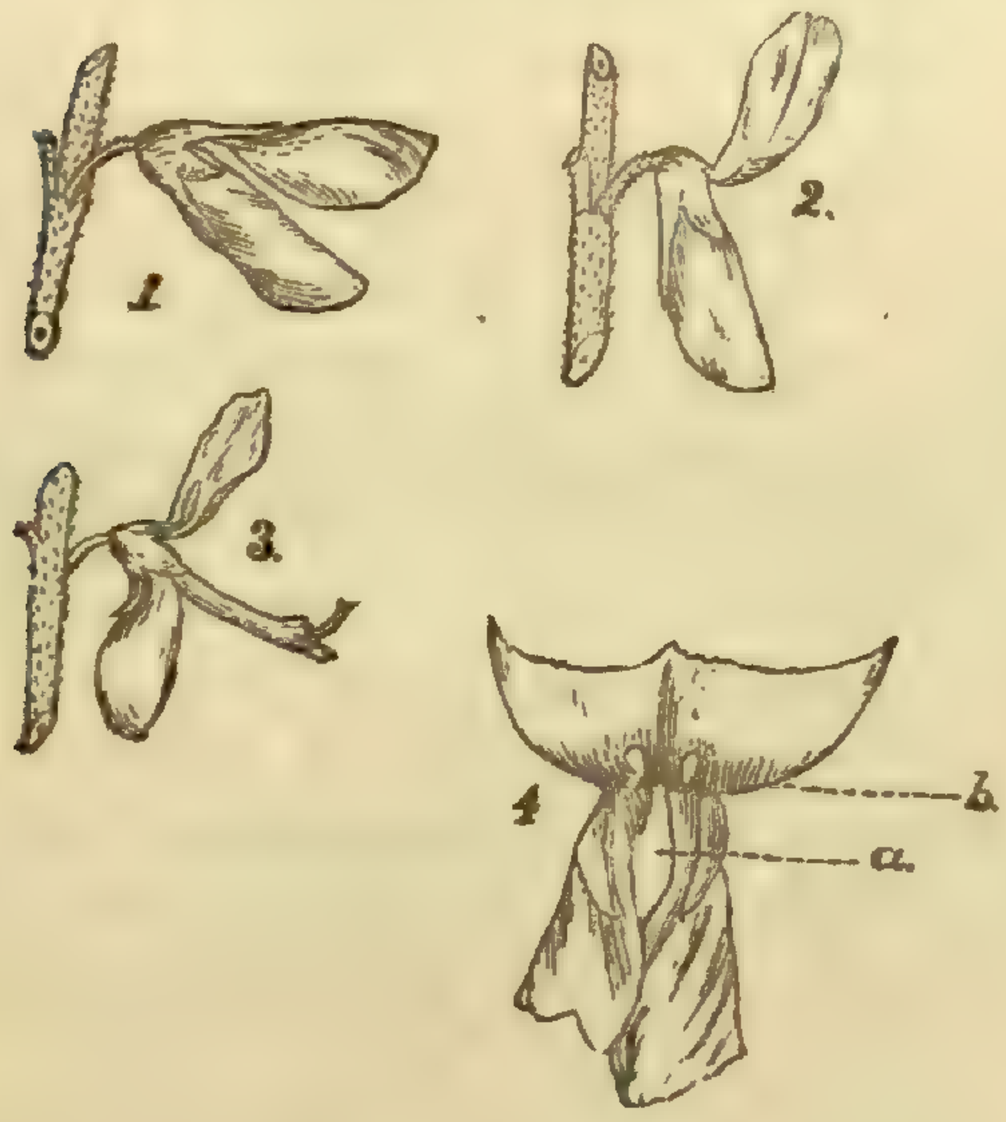


FIG. 1.—Flower when first opened; and before the petals begin to reflex. FIG. 2.—The same with the petals reflexed; the flower in a state of tension. FIG. 3.—The same after the stamens have sprung out from the wings and keel. Fig. 4.—Front view of the base of the standard (cut away above) and the bases of the wings, showing at *a* the opening to the honey reservoir, and at *b* the eye-spots. 1, 2 and 3 natural size, 4, enlarged.

A little examination will show that many of the flowers have changed the relation of their parts, the tension being in a great measure relieved (Fig. 3). A closer inspection shows that when the flower is in a state of tension, the stamens and pistil are forcibly drawn downward, as one might draw down the end of a stiff spring. Now in the later flowers mentioned above (Fig. 3), the stamens and pistil have escaped from the deflexed keel and occupy their normal position in the axis of the flower.

If we now take a flower in its state of tension and look down between the separated standard and wings, we notice upon the dark-colored base of the standard two bright yellowish-white eye-like spots which show with remarkable distinctness upon the dark background (*b* Fig. 4). Directly in front of these there is an opening left between the approximated edges of the wings (*a* Fig. 4); this opening appears to be the entrance to the store of honey. Suspecting this and also that the eye-spots had some function, I began feeling the surface of the standard and the wings and the interior stamen tube, in the vicinity of the eye-spots, using a pencil point, with the result that whenever the standard was gently pushed backwards by a touch near the eye-spots, the stamens and pistil would be freed with a violent jerk. The experiment was repeated again and again, invariably with the same result. I was not fortunate enough to observe insects "springing" these traps, but from the fact that nearly every flower upon an exposed plant eventually is thus opened, there can be no doubt that insects do spring them open. This is rendered still more certain by the

fact that flowers brought into my laboratory where they were not visited by insects, although they were kept in water, did not spring open. Repeated trials under different conditions showed that at the instant the sensitive surface was touched, the basal third of the wings and keel became strongly curved, and that this brought so great a tension upon the stamen-tube and pistil that the latter could not be held longer by the petals, as a bow when bent too far snaps its string and frees itself.

The purpose of this ingenious mechanism is obvious. When the stamens spring out with such violence they throw the pollen forcibly against the body of any insect hovering over the flower or resting upon its wings and keel.—*Charles E. Bessey.*

Botanical News.—The March and April numbers of the *Western Druggist* contain an interesting paper on plant hairs by Professor E. S. Bastin of Chicago. It is illustrated by numerous wood-cuts.——In a recent number of the *Gardeners' Chronicle* Mr. W. G. Smith furnishes an illustration of *Peronospora effusa.* It is in his well-known style, a style against which we are moved to protest vigorously. Conventionalized plant figures may be permissible in art, but certainly they are not in botany.——Recent numbers of *Flora* (Regensberg) contain a paper on the lichens of the French Jura mountains, by Dr. F. Arnold.——The most interesting paper in the May *Journal of Botany* is one by Mr. Spencer Moore upon the Identity of *Bacterium fœtidum* of Thin, with soil Cocci, in which it is shown that the bacteria which produce or accompany "the sweating of the feet" are identical with those producing chemical action in the soil. In the latter situation they reduce the sulphates to sulphites, and the phosphates to phosphites, and in both situations are instrumental in setting free ammonia.——Dr. Vasey's Descriptive Catalogue of the Grasses of the United States, just received, is a valuable contribution to the literature of our Gramineæ. The genera are described, and under each are arranged all the species which occur within the limits of the United States. A few synonyms are given, enough to enable one to use the catalogue in connection with the older manuals. A summary at the end of the volume gives the whole number of genera in the United States as 120, and of species 675. Following the catalogue proper is a synopsis of the tribes of North American grasses based upon Bentham and Hooker's arrangement in the Genera Plantarum. Two years ago the same author published a somewhat similar catalogue in which there were 114 genera and 589 species. We will repeat what we have said several times already, that work of this kind coming from the Department of Agriculture at Washington tends to raise the value of the department in the eyes of the scientific men of the country.

ENTOMOLOGY.

UNUSUAL NUMBER OF LEGS IN THE CATERPILLAR OF LAGOA.—*Lagoa crispata* Pack. is an interesting moth forming a connecting link between the Dasychiræ (Orgyia) and the Cochlidiæ, represented by Limacodes and its allies. As we remarked in our Synopsis of Bombycidæ (1864): "When we observe the larva we would easily mistake it for a hairy Limacodes larva, for like them the head is retracted, the body is short, and the legs are so rudimentary as to impart a gliding motion to the caterpillar when it moves." After describing the transformations, we added: "There are seven pairs of abdominal or false legs, which are short and thick. The first pair of thoracic or true legs are much shorter than the two succeeding pairs."

Lagoa.

Two years ago we found the fully fed caterpillars and also those before the last molt on scrub-oaks in Providence, and again noticed them while walking, then carefully examined them after placing them in alcohol, and again examined the specimens during the past winter. It is well known that caterpillars have no more than five pairs of "proplegs," "false legs" or abdominal feet, as they are variously called; and so far as we have been able to learn the present caterpillar is the only one which has additional legs, even though rudimentary. As in all lepidopterous larvæ, there are ten abdominal segments. In the larvæ before the last molt there is a pair of rudimentary abdominal legs on the second abdominal segment, forming soft tubercles about one-third as large as the succeeding normal feet; the crown of hooks was wanting, but a tubercle on the anterior side corresponding to a similar one on the normal feet had five or six well marked stout spines, also two or three scattered ones in the middle, the tubercle being rounded, convex, not flattened at the end.

On the sixth segment, following the fourth pair of normal abdominal legs, is a pair of tubercles like those on the second segment and exactly corresponding in situation with the normal legs; situated externally are two long straight spines, but none homologous with those forming the crown. At the base in front of each tubercle is a tuft of sparse hairs, and on the outside is a chitinous spot bearing a dense tuft of hairs; these two tufts precisely agree in situation and appearance with those at the base of normal abdominal legs.

In the fully fed caterpillar the tubercles are exactly the same. It thus appears that in the Lagoa larva the first abdominal segment is footless; the second bears rudimentary feet; segments 3–6 bear normal proplegs; the seventh bears a pair of rudimentary legs; segments eight and nine are footless, while the tenth bears the fully developed anal or fifth pair of genuine proplegs.

While these two pairs of tubercles differ from the normal legs

in being much smaller and without a crown of curved spines, they are protruded and actively engaged in locomotion, and in situation, as well as the presence of the basal tufts are truly homologous with the normal abdominal legs.

When we turn to the work of Kowalevsky on the embryology of Sphinx, we find that it has ten pairs of abdominal legs which arise in the same manner as the thoracic or chitinous, jointed legs. Of these ten pairs one half disappear before hatching, leaving the five pairs usually present. It seems to us that the two pairs of rudimentary legs in Lagoa are survivals of these embryonic temporary feet. Although the proplegs are not popularly regarded as true legs, they are undoubtedly so, as embryology proves. In the lower Noctuidæ, such as Catocala, Aletia, etc., the larvæ are at first geometriform, having but three pairs of proplegs; in the geometrids there are but two pairs, while in the Cochlidiæ there are not even any rudimentary feet, thoracic or abdominal. As we have elsewhere observed, the primitive lepidopterous larva must have had a pair of feet on each abdominal segment, and may have descended from Neuroptera-like forms allied to the Panorpidæ as well as Trichoptera.—*A. S. Packard.*

Use of the Pupæ of Moths in distinguishing Species.—In describing the pupæ of certain moths we have found it well to observe and note with care the shape and appendages of the terminal spine of the abdomen. This has been done to some extent, but our experience teaches us that there are, in a great number of cases, excellent specific or at least generic characters in these parts. In the Bombycidæ, the Notodontians especially, and in the Geometridæ as well as the Phycinæ and Tortricidæ, there are notable differences between those species which do or do not spin a cocoon, the latter attaching themselves by a mass of silk to the leaves, the spines and setæ giving them a firm hold. In those living among leaves or in the earth, the spine is provided with long curved setæ arising from the end and sides of the spines; these vary much, as does the abdominal tip in general in different species of Acrobasis, according as they live simply between leaves or in a cocoon. In some Notodontians which make a cocoon, as in *Lophodonta angulosa*, the tip of the abdomen is blunt, ending in a rounded knob, with no rudiment of a spine.

In *Dalana ministra* the obtuse tip of the abdomen is divided into a stumpy short bifid spine, each division ending in two spines, with an external shorter third minute one at base.

In *Edema albifrons* the tip proper ends in a short spine, which is flattened vertically, deeply cleft, with tubercles, from which arise 3–4 curved setæ on each side, the entire apparatus retaining a firm hold on the end of the mass of silk by which it adheres to the leaves.

In the pupa of *Lochmæus tessella* the tip is flattened vertically

and very deeply cleft, each fork ending in a short lateral excurved hook, but with no setæ. This form lives in a slight cocoon, where it has no need of hooks.

In Bombycidæ, such as *Eacles imperialis*, which enters the earth and makes no cocoon, the use of the large caudal spine is as plain as in the pupæ of the Sphinges; so also in the species of Anisota and Dryocampa.

In the Geomtrids and Tortricids there are, in the abdominal spine and hooks, excellent generic and specific characters, as I have found in different species of Teras, etc.—*A. S. Packard.*

Swarming of a Dung-Beetle, Aphodius inquinatus.—About the first of last October, while riding along a country road near Ripon, my attention was attracted to a dark mass of living matter in the road. On examination it proved to be a host of *Aphodius inquinatus*, engaged with horse dung. They were in two or three masses, whose areas averaged perhaps three square feet each, and were piled up two or three deep. So many, too, were flying about in the air that as I rode along I could, with a single motion of the hand, catch from two or three to half a dozen. Nor were they confined to this one place, for they appeared in considerable numbers at a distance of at least a mile from the point at which I first noticed them.—*C. Dwight Marsh, Ripon, Wis.*

Insect Pests on the Pacific Coast.—California seems to be overrun the present year with insect plagues. Not only are vast swarms of the genuine locust devastating the crops in Placer, Yuba, Navada, Amador, Napa, Sonoma, San Joaquin, Butte, Sacramento, El Dorado, Tehama and Mercer counties, but the wheat fields in Alamada, Napa, Sonoma and Solano counties are being very seriously injured by the Hessian fly, an insect which has hitherto been supposed not to occur on the Pacific coast. Professor Riley, the United States Entomologist, has received specimens, and they prove to be the true Hessian fly.

Entomological Notes.—In Siebold and Kölliker's Zeitschrift, issued May 8th, A. Sommer has an elaborate and well illustrated article on the anatomy and histology of the large common Poduran, *Macrotoma plumbea;* the descriptions, however, do not appear to be comparative. In the same number is an essay, with many illustrations, on the embryology of the mole cricket (Gryllotalpa), by A. Korotneff.——Another paper on the embryology of insects is one by Dr. Tichomirow, on the earlier stages of development of the silk worm *(Bombyx mori)*. His observations deal with the process of segmentation, the first development of the heart, and on the occurrence of an inner skeleton in the head of the insect. He then discusses the chemical properties of the eggs. His paper was presented to the Physiological Society of Berlin, and is reported in *Nature* for April 30.——In the *Quarterly Journal of Microscopical Science*, for April, Sidney J. Hickson

discusses the eye and optic tract of insects, his observations corroborating the opinion of the majority of previous investigators, that the retinulæ are the true nerve-end cells, while Mr. F. S. Heathcote describes a peculiar sense organ in the Myriopoda, *Scutigera coleoptrata.*——A report on the anatomy of the cotton worm moth *(Aletia xylina)* by C. S. Minot and E. Burgess, extracted from the Fourth Report of the U. S. Entomological Commission, is illustrated by five plates. They describe a membrane on the metathorax of the moth, which they regard as probably homologous with the tympanal membrane or "ear" of the locust (Acrydium).——In Biologisches Centralblatt, Feb. 1, Dr. Dewitz describes the hooked hairs of Chrysopa larvæ, and a male sexual character in Catocala, which consists of a tuft of hairs which lies in a furrow on the middle femora, and which rises like a fan out of the furrow; this has been previously noticed in this country.——In an article on the development of *Sphærularia bombi*, in Zool. Anzeiger for May 11, Professor Leuckart maintains that this parasite of humble bees is nothing else than the female sexual apparatus of a nematoid worm, a kind of transplanted organ which meets with the proper conditions for existence in the body of a foreign host.

ZOOLOGY.

Indestructible Infusorial Life.—J. Hogg describes some further experiments he has made on this subject, supplementing those previously recorded on rotifers. Some Ciliata and Tardigrada have been included, and these have, although not to the same degree, exhibited a remarkable tenacity of life. The intervals of sleep and vigorous life have also been brought into strict accord with the durations of dry and wet periods of the year, so that the subjects of the experiments have been kept in a perfectly dry condition during the whole of the long drought which characterized the past summer.

Moreover, some older dried specimens were subjected to an artificial process of desiccation. They were kept for a time in a hot-air chamber, the heat in which was raised to 2000 F., and subsequently the miniature aquarium in which they were inclosed was plunged into a freezing mixture. Neither process killed them nor greatly diminished their vital powers, their revivification in both cases being somewhat delayed. Certain poisons known to exert a baneful influence over higher animals were added to the water supplied to the rotifers, but in no way did they produce discomfort; on the contrary, portions were taken into the stomach and partly digested. On the other hand, a drop of sewage water caused marked discomfort; they immediately retracted their rotating organs and sank to the bottom of the cell. These were, so far as could be ascertained, poisoned, and this was probable owing to the free sulphide of hydrogen evolved by the putrescent sewage. From

his observations the author is led to infer that rotifers will live and multiply on a very scanty supply of organic matter, provided only that the water is fairly well oxygenated. Attention is also called to the greatly diminished or no longer developed eye, due, no doubt, to the withdrawal of the stimulus of light, the rotifers being nearly always kept in the dark.—*Journal of the Microscopical Society, February, 1885.*

ON THE MORPHOLOGY OF THE CARPUS AND TARSUS OF VERTEBRATES.—As a result of embryological and literary studies I reach the following morphological table for the carpus and tarsus :

MAMMALIA.	URODELA (Menopoma, Cryptobranchus, Salamandrella, Ranodon, Axolotl).		MAMMALIA.
Carpus.	*Carpus.*	*Tarsus.*	*Tarsus.*
Scaphoideum	Radiale	Tibiale	Sesamoid articulating with naviculare and astragalus.[1]
Lunatum (intermed. Gegenbaur)	Centrale I[2]	Centrale I[3]	Distal part of astragalus.
Pyramidale (ulnare Gegenbaur)	Intermedium	Intermedium	Proximal part of astragalus (os trigonum Bardeleben).[4]
Pisciforme[5]	Ulnare	Fibulare	Calcaneus.
Centrale (Rosenberg)[6]	Centrale II	Centrale II	Naviculare.
Carpale of the rudimentary radial digit[7]	Carpale I	Tarsale I	Tarsale of the rudimentary tibial digit.[8]
Trapezium (carp. I Gegenb.)	Carpale II	Tarsale II	Cuneiforme I (tarsale I Gegenbaur).
Trapezoideum (carp. I Gegenb.)	Carpale III	Tarsale III	Cuneiforme II (tarsale II Gegenb.)
Magnum (carp. III Gegenb.)	Carpale IV	Tarsale IV	Cuneiforme III (tarsale III Gegenb.).
Unciforme (carp. IV and V Gegenb.)	Carpale V[9]	Tarsale V	Cuboideum (tarsale IV and V Gegenb.).
Metacarpale of rudimentary radial digit[10]	Metacarpale I	Metatarsale I	Metatarsale of the rudimentary tibial digit.[11]
Metacarpale I autorum	Metacarpale II	Metatarsale II.	Metatarsale I autorum.
Metacarpale II autorum	Metacarpale III	Metatarsale III	Metatarsale II "
Metacarpale III autorum	Metacarpale IV	Metatarsale IV	Metatarsale III "
Metacarpale IV autorum	Metacarpale V[12]	Metatarsale V	Metatarsale IV "
Metacarpale V autorum	Metacarpale VI[13]	Metatarsale VI[14]	Metatarsale V "

[1] Baur, G., On the morphology of the tarsus in the mammals. AMER. NATURALIST, Jan., 1885, pp. 87–88.

Baur, G., Zur Morphologie des Tarsus der Säugethiere. Morphol. Jahrb., Bd. 10, Heft 3, 1884, pp. 458–461.

Albrecht, G., Sur les homodynamics qui existent entre la main et le pied des mammifères. Presse médicale belge, No. 42, du 19 octobre, 1884, pp. 10.

Bardeleben, R., Zur Entwicklung der Fusswurzel. Sitsungberichte Jenaische

Now the question is, where are to be found the relations to the reptiles, from which mammals have probably descended? I cannot look for the six-toed forms with paddles, Ichthyosaurus, Baptanodon (Sauranodon), Plesiosaurus, etc., for I consider those modified in the same way as the cetaceans. In the living lacertilians and chelonians we find the same condition in the carpus,

Gesellschaft für Medicin und Naturwissenschaften. Jahrg, 1885. 3. Sitzung vom 6. Februar, pp. 5.

Cope, E. D, Fifth contribution to the knowledge of the fauna of the Permian formation of Texas and the Indian Territory. Read before the American Philosophical Society, August 15, 1884. Palæont. Bull., No. 39, pp. 38–41, p. 46.

Marsh, O. C., Dinocerata, a monograph of an extinct order of gigantic mammals. U. S. Geol. Survey, Vol. x, 1884, p. 146.

[2] (*Ranodon sibiricus*, *Salamandrella keyserlingii*, *Salamandrella* (*Isodactylium*) *wosnessenskyi*.) Wiedersheim. R., Die ältesten Formen des Carpus und Tarsus der heutigen Amphibien. Morphol. Jahrb., Bd. II, 1876, Taf. XXIX.

[3] (Cryptobranchus, Menopoma, Ranodon, Salamandrella, Axolotl.) Hyrtl, J., *Cryptobranchus japonicus*, *Schediasma anatomicum*, Vindobonae, 1865, Tab. VI, VII.

Van der Hoeven, T., Note sur le carpe et le tarse du *Cryptobranchus japonicus*, Archives Néerlandaises, T. I, 1866, pp. 22, Fig. 2 (extr.).

Wiedersheim, R., l. c. and Nachtraegliche Bemerkungen zu seinem Aufsatze. Die ältesten Formen des Carpus und Tarsus der heutigen Amphibien. Morphol. Jahrb. Bd. III, 1877, pp. 154, Figs. 2, 3, 5.

[4] Bardeleben, R., Das os intermedium tarsi der Säugethiere. Zool. Anzeiger, VI Jahrg., No. 139, 21 Mai, 1883, p. 280.

Albrecht, P., Das os intermedium tarsi der Säugethiere. Zool. Anzeiger, VI Jahrg. No. 145, 6 Aug., 1883, pp. 419–420.

Bardeleben, R., Ueber das Intermedium tarsi. Jena. Sitzungsber., 1883, 8. Juni; and loc. cit. (I have not been so happy till now to find this bone in embryos of man, Insectivora, Rodentia, Carnivora.)

[5] Leboucq, H., Recherches sur la morph. du carpe chez les mammifères. Arch. de Biologie, Tome V, 1884.

Albrecht, P., Sur les homodynamies, etc.

[6] Rosenberg, E., Ueber die Entwicklung der Wirbelsäule und das Centrale carpi des Menschen. Morph. Jahrb., Bd. I, 1876.

Leboucq, H., Recherches sur la morphologie du carpe chez les mammifères. Arch. de Biologie, Tome V, 1884.

Baur, G., Ueber das Centrale carpi der Säugethiere. Morphol. Jahrb., Bd, 10, Heft 3, 1884.

Baur, G., On the centrale carpi of the mammals. AM. NAT., Feb., 1885.

[7] I found in a *Phalangista cookii* of 30^{mm}, received through the kindness of Professor Marsh, a rudimentary radial digit consisting of two pieces, a carpale and a metacarpale. The same condition I found in a skeleton of an adult *Chiromys madagasc.* The "sesamoid of the abductor pollicis" represents this element.

[8] I found in a *Didelphys virg.* of 15′ ^{mm}, for which I am indebted to Professor Osborn, a rudimentary tibial digit consisting of two pieces, a tarsale and a metatarsale. Conf. Bardeleben, K., Zur Entwicklung der Fusswurzel l. c. Rudiments of this digit are present in the Monotr., Rodentia, Carniv., Edent., Insectiv.

[9] This element probably existed in the Permian Urodela with five toes in the hand, and will probably be found in very young Urodela.

[10] Conf. 7.

[11] Conf. 8.

[12] Present in the Permian Urodela.

[13] Not yet found.

[14] I regard the piece in Cryptobranchus and Ranodon, hitherto considered a sixth tarsal bone, as the sixth metatarsal bone.

considering the "sesamoid" on the ulnar side, the pisiforme, *i. e.*, the ulnare; but it has not been possible hitherto to homologize directly the tarsus of the lacertilians and chelonians with that of the mammals. The Theromorpha of Professor Cope give the missing link. I believe with Professor Cope that "the subcylindric proximal part of the astragalus" is the intermedium (Professor Cope calls it erroneously centrale, but corrects this p. 46). In the distal part of the astragalus I see the first, and in the navicular bone the second central bone of Cryptobranchus, etc.

My further studies will be devoted to the morphogeny of the carpus and tarsus of the Sauropsidæ, and I shall be very much obliged to any one who may kindly aid me with material for examination.—*Dr. G. Baur, Yale Col. Mus., New Haven, Conn., April 12th, 1885*

A Black-footed Ferret from Texas.—I recently received from Mr. G. H. Ragsdale a specimen of the black-footed ferret, *Putorius nigripes*, captured near Gainesville, Cooke county, Texas. This is the second specimen of the species from Texas thus far recorded. The first was noted by Dr. Coues in this journal, in 1882 (Vol. xvi. p. 1009), and came from Abilene, Taylor county, near the centre of the State.—*F. W. True, Curator of Mammals, Smith. Institution.*

Zoological News.—*Vermes*—Robert Scharff (Quart. Jour. Micros. Soc.) gives the result of his investigations upon the skin and nervous system of *Priapulus caudatus* and *Halicryptus spinulosus*. The skin consists of a cuticula and hypodermis, with an extremely thin layer of connective tissue or cutis. The nervous system lies entirely in the ectoderm.

Polyzoa.—S. F. Harmer (Quart. Jour. Micros. Soc) contributes a paper upon the structure and development of Loxosoma. The investigations were carried on upon five species found at Naples. He concludes that "in order to understand correctly the phylogeny of the Polyzoa we must derive the group from a trochosphere-like organism, and that the Entoprocta have remained permanently at a grade hardly higher than that of this hypothetical ancestor. Loxosoma shows itself the most primitive genus by the fact that it forms no colonies, by the greater development of the brain in the larva, and by the invariable presence of a foot-gland in the buds, if not in the adult." The similarity between Loxosoma and a molluscan larva (Dentalium) is pointed out, and the author concludes that "of all organisms with whose ontogeny we are acquainted, the Mollusca come nearest to the Polyzoa," and that the Rotifera must be near the Polyzoa in many points; while the Brachiopoda are much less close.

Tunicata.—M. L. Roule has described three Phallusiadæ from the coasts of Provence in addition to the two recently described by him. One of these is intermediate between Molgula and

Eugyra; while the others belong to the genera Microcosmus and Cynthia.

Echinoderms.—The stalked crinoids collected by the *Challenger* and reported upon by Dr. P. H. Carpenter, raise the total of existing generic forms to six, with no less than thirty-two species. The bathymetrical range of the tribe is shown to extend from 100 fathoms to 2500. No less than 150 species of unstalked crinoids were collected by the same expedition. In the discussion of the morphological relations between the neocrinoids and the palæocrinoids, Dr. Carpenter is, upon certain points, at issue with Mr. Wachsmuth, the highest authority on the latter group. Of the species of Pentacrinus from West Indian seas, *P. asterias*, the *Isis asterias* of Linnæus, is the rarest, while *P. decorus* is far more plentiful than *P. mulleri*. Neither of these, nor *P. blakei*, have been met with elsewhere. Two species from the Western Pacific, one from the North Atlantic, on the European side, another from the tropical Atlantic, and a single mutilated type from the Japan sea, complete the known Pentacrini. There is, in fact, but little difference between this genus and Comatula, the chief distinction being that the basals of the pentacrinoid larva are retained in the adult Pentacrinus, whilst they disappear externally in Comatula. Living Comatulæ only perform their beautiful swimming movements in order to find a suitable base to which they can attach themselves by their dorsal cirri; while the stalked Pentacrini are not seldom detached by the fracture of their skins just below a nodal joint, and they then cling to any suitable attachment by means of the cirri of that joint, which bend downwards like the dorsal cirri of Comatula. The five-chambered organ at the base of the calyx is much smaller in Pentacrinus than in Comatula, but each node of the crinoidal axis presents a dilatation similar to the five in Comatula. In the Eastern Archipelago Pentacrinus is replaced by the allied Metacrinus, eleven species of which were dredged by the *Challenger*.

Crustacea.—W. B. Spencer (Quart. Jour. Micros. Soc.) describes the urinary organs of the Amphipoda, which consist of cæca opening into the posterior part of the intestine. They are present in Gammarus, Orchestia, Talitrus, and Caprella. Mr. Spencer concludes that these organs of strangely limited distribution amongst crustacea are excretionary and probably urinary, but present knowledge does not warrant us in regarding them as strictly homologous with the Malpighian tubes of Tracheata.

M. Y. Delage has discovered a nervous system in Peltogaster, which had before been believed to be without one. Eighteen months previously the same naturalist found a nervous system in Sacculina.

Mammals.—According to F. W. True, in a communication to *Science*, the milk of *Tursiops tursio* is of the color and consistency

of cream, without perceptible odor, and with the flavor of cocoa-nut milk. The fishermen state that this species, which is the one most common on the Atlantic coast, cannot remain under water more than four or five minutes. The color of the back, in some examples taken at Cape May Point, was a light plumbeous tint, but it appears that the depth of the color varies in different individuals, and deepens rapidly after life is extinct, especially if the specimens lie in the sun.

M. Paul Albrecht, in the *Pressé Medicale Belge*, 1884 (October), states that there are fourteen digits in the vertebrate foot. Seven of these are radial and tibial, one is axial, and six are ulnar and fibular.

M. Retterer, in a thesis presented to the Faculty of Sciences of Paris, describes the early stages of the limbs and feet in various mammalia. He shows that the primitive cartilages display the same numbers and character as the bones of the adults in a great many cases.

EMBRYOLOGY.[1]

On the Embryology of Limulus polyphemus.[2] III. — The stage under examination is that represented on Figs. 12 and 13, 14 and 15 (Plates III and IV) of my essay on the development of Limulus (Memoirs Boston Society Natural History, 1872). At this stage the oval blastodermic disc, with the six pairs of the cephalic appendages, is distinctly formed; the mouth is seen in a position in front of the first pair of appendages, and from it the primitive streak passes back to the posterior margin of the blastodermic disc or "ventral plate." The abdomen is separated from the head by a curved groove, as seen in Fig. 12 of my memoir.

The period examined is an interesting one, as while the cephalic appendages were well developed the abdominal appendages were not as yet indicated, nor the post-oral nervous ganglia.

The first point, which at once excited my attention, was the nature of the embryonic membrane, which I had previously regarded as the homologue of the amnion, and afterwards as the serous membrane of insects, but which Mr. J. S. Kingsley[3] has found to be secreted from the blastoderm. A thin section (Plate XXIV, Figs. 1 and 5) shows that the membrane is very thick, structureless, the cellular appearance being confined to the external surface. This membrane is evidently secreted by the blastoderm; the irregular cell-like markings (see my second memoir, 1880, Pl. III, Figs. 14, 14*a*, 14*c*, 14*d*) are, so to speak, casts of the blastoderm cells, which with the marks of even their nuclei are impressed upon the membrane during the early stage in its forma-

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

[2] Read before the American Philosophical Society, January 16, 1885.

[3] The Development of Limulus, *Science Record*, II, pp. 249–251, Sept., 1884.

tion; after a while new matter is added to the interior which is structureless, so that the cellular appearance is only superficial. In my comparison of this membrane with the serous membrane, I certainly exaggerated its resemblance to the *serosa* of insects, as the latter is a much more delicate membrane, and with a characteristic appearance in Crustacea, the scorpion, myriopods and hexapods. The membrane in question appears to have its homologue, however, in the embryonic membrane of Apus, which we have described in a foot-note on p. 161 of our first memoir. It thus appears that this supposed point of resemblance in Limulus to the Tracheata is removed.

A longitudinal section of the embryo of Limulus is represented by Fig. 2. The section passes through the blastodermic disc (ventral plate) and the indications of the appendages, on one side of the median line of the body. The epiblast entirely surrounds the yolk, forming a thin layer with nuclei, the cell walls not being distinct, while the nucleolus consists of a number of granules. The nuclei are two deep only on the cephalic portion of the embryo. The blastodermic disc does not extend quite half way around the egg. The six pairs of appendages are well developed, increasing in size from the first to the last pair. The mesoblast is now well developed; the nuclei well marked, but the cellular walls more or less effaced. The mesoblastic arthromeres are now well indicated. The somatic cavities are well marked in each appendage; the somatopleure is from one to three cells deep; the splanchnopleure is formed usually of two layers of cells, and is more or less continuous at the ends of the somatic cavities with the somatopleure. The relations of these divisions of the mesoblast, which are destined to form the muscles of the limbs and the ventral aspects of the body, are represented in Fig. 3.

The mesoderm, as seen in Fig. 3, is now differentiated into three sublayers: 1, the somatopleure; 2, the splanchnopleure, and 3, a sublayer from which probably arises, in part at least, the connective tissue so remarkably developed in the head of Limulus; in its thickest portion at this stage this innermost layer consists of about eight series of cells, which are more loosely arranged than in the sublayers next to the epiblast.

The yolk granules are minute, the largest granules not more than twice as large as the nuclei of the mesoderm. The hypoblast cells are by far the largest cells in the embryo, and at once attract attention by reason of their size and their deep color when stained; the nucleus and nucleolus are well marked. At this stage no hypoblast cells could be detected in the yolk, nor any protoplasmic network connecting them. Those present formed a dorsal row ranged next to the thin epiblast over about one-quarter of the periphery of the ovum. In an earlier stage, however, the yolk granules are contained in distinct polygonal cells, forming a network extending through the yolk.

The abdomen has not yet undergone segmentation; the incipient steps are represented in Fig. 2, where there appear to be arising five mesoblastic segments (1, 2, 3, 4, 5). Between the first and second mesoblastic mass is a narrow cavity which sends a branch forward to the base of the abdomen, and a second obliquely downward and inward; at 2 and 3 in Fig. 2 there are narrow cavities or splits (somatic cavities?) which communicate with a longitudinal internal opening, which extends in a direction parallel to the under (now outer) surface of the abdomen. In this respect the embryo of Limulus is very different from that of the scorpion and spiders (see especially Balfour's Figs. 5, 6, Pl. XIX, and Fig. 15, Pl. XX), where the abdominal segments, with their appendages and somatic cavities are formed contemporaneously with those of the cephalothorax. The innermost mesodermic cells are now arranged in long cords, destined to form the ventral adductor muscles of the abdomen.

The mode of formation of the head and its shape at this time presents important differences from that of tracheate embryos. The procephalic lobes are not developed; the preoral portions of the head, *i. e.*, that part in front of the first pair of limbs is very small, short and narrow, merely forming the end of the oval blastodermic disc, seen in my earlier published figures. The structure of the preoral portion of the head (*procephalum* as we may term it), is seen in longitudinal section in Fig. 3, *pc*, to apparently consist merely of an extension of the postoral part of the head; with apparently one or two splits in the mesoderm (ms^1, ms^2), the nature of which I do not understand; undoubtedly farther sections and comparisons will throw light upon it.

The first nervous ganglion is seen at Fig. 5 to result (as also first shown by Kingsley) in an ingrowth of the epiblast (*inv. c*); carrying into the interior a mass of epiblastic nuclei, which envelop the myeloid substance (*my*), which, as in older embryos, remains unstained by the carmine.

The mesoblastic nuclei stop at a large cell (*c*), beyond which are long incipient loose muscle-cells with a few scattered nuclei.

The procephalum terminates abruptly, forming, as seen in our earlier figures already referred to, the end of the blastodermic disc.

The absence of the procephalic lobes in the embryo Limulus of this stage seems to us to be a very significant fact, and to point to the early divergence of the Palæocarida from the stem leading up to the Tracheata, and especially the Arachnida. Metschnikoff's researches on Scorpio, with those of Claparède, and of Balfour on the spiders, and those of Sograff on the myriopods, show that this is a fundamental and early attained feature in these types. Their absence in Limulus shows how little its embryo has in common with tracheate embryos. At the same time the general mode of formation of the blastodermic disc (ventral plate) of

Limulus is much like that of the spider, as seen in the mode of origin of the mesoblastic segments and the probable origin of the hypoblastic cells. There is a superficial resemblance between the embryo of Limulus and of the spider, as may be seen by a comparison of our Fig. 2 and Balfour's Fig. 15. Without much doubt the Tracheata and Palæocarida, as well as Crustacea Neocarida, branched off from a common ancestor, but the more important morphological points show that the terrestrial, air-breathing tracheates were a much later branch of the arthropod tree than the marine branchiate Palæocarida and genuine Crustacea. Probably the Palæocarida (Limulus and other Merostomata, and Trilobita) were the earliest arthropods to appear; after them arose the Crustacea, perhaps at nearly the same time the Arachnida, and finally the Myriopoda and the winged insects. Without much doubt the earliest branchiate forms were our Protocyclus,[1] the ancestor of the Palæocarida; and a protonauplius form, the forerunner of the Crustacea; these were marine, perhaps branchiate organisms, with a few pairs of simple oar-like swimming appendages either around or just behind the mouth, and which were free-swimming or creeping forms; the Protocyclus was, perhaps, a solid oval creeping animal living at the bottom on mud or sand. The branchiæ probably became first developed on the limbs of the free-swimming Protonauplii, as they needed, owing to their great rapidity of movement, the means of rapid aëration of the blood; while in the heavily molded less oxygen-consuming Protocyclus, the evolution of gills was somewhat postponed. The steps from Protocyclus to Agnostus was not a very long one. The oldest arthropods, notwithstanding the recent discovery of a Silurian scorpion, were trilobites.

The following conclusions are drawn from a study of the stage of Limulus here figured.

The fact that the embryo Limulus had at first no abdominal appendages (uropoda), whereas there are temporary abdominal appendages in the tracheates, shows that Limulus in this important respect has little in common with the Arachnida, Myriopoda or Hexapoda. On the other hand in the embryo Crustacea the cephalic limbs are first indicated; the nauplian limbs as well as the zoëan appendages being cephalic; the uropods not appearing until after the Crustacea leave the egg.

These facts indicate that Limulus probably descended from a type in which there were cephalic appendages only, and no abdominal appendages. The absence of a serous membrane, of an amnion, and of procephalic lobes, of temporary embryonic abdominal appendages (at the stage above described); also of protozonites (seen in the early embryo of the scorpion and spider) tend to prove that the embryo of Limulus has little in common with that of Tracheata.

[1] See Development of Limulus, 1872, p.

On the other hand the earlier stages in the embryology of Limulus resemble those of Crustacea in the absence of the procephalic lobes; in the primitive development of cephalic appendages alone; the comparatively early appearance of the branchiæ of Limulus in the stage succeeding that figured in this essay, shows that the Limulus probably never had any genetic connection with a tracheate arthropod.

On the other hand, the tracheate features of mesoblastic somites are also seen in the worms, in Peripatus and in Annelida.

It appears that the embryology of Limulus is scarcely more like that of tracheates than Crustacea; it is a very primitive type standing nearer the branchiate arthropods than the tracheate, but on the whole should be regarded as a generalized or a composite form, which with its fossil allies, the Eurypterida and Trilobita, form a class by themselves with a superficial resemblance to the Arachnida.

It seems to us that the above-mentioned characters, which separate the early embryo of Limulus from the tracheates, are as important, if not much more so, than those of the absence at first of an archenteric cavity or differences in the mode of origin of the mesoblast, noted by Mr. Kingsley in his brief paper on the development of Limulus. In these general, primitive embryonic characters Limulus appears to be as nearly allied to the annelids as to the tracheates; and too much dependence should not, it seems to us, be placed upon them in seeking to establish the true relations of the Palæocarida among the arthropods. In the higher worms the two longitudinal mesoblastic bands split into somatic and splanchnic layers (Kowalevsky). In Mysis Metschnikoff states that the mesoblast becomes broken up into distinct somites (Balfour's Embryology, I, 436). If so, then this character is not one of much importance to separate Limulus from the Crustacea. The ultimate origin of Limulus from the same stock as that which gave rise to the modern annelids seems not improbable.

EXPLANATION OF PLATE XXIV.

FIG. 1.—Blastodermic cuticle (*bl. cut*) lying upon the epiblast (*ep*). The nuclei scattered through the latter; the nucleolus in these as well as the mesoblast cells, consisting of a number of granules. × $\frac{1}{5}$ A.

FIG. 2.—Longitudinal section through an embryo before the appearance of the abdominal appendages, but after the rupture of the chorion; the section passes through the six cephalic appendages (I–VI), showing the somatic cavities (*ms*), the splanchnopleure (*sp*), and somatopleure (*so*); 1–5, the indications of the five primitive uromeres; *hy*, hypo- or ectoblast. × $\frac{1}{5}$ A.

FIG. 2*a*.—Showing the relations of hypblastic cells (*hy*) to the epiblast (*ep*) in the dorsal region of the embryo.

FIG 3.—Longitudinal section of the head and the first three appendages; ms^1, ms^2, first and second somatic cavities in the preoral region of the head. This figure also shows the relations of the splanchnopleure and somatopleure to the epiblast. *c*, large distinct cell in preoral region. × $\frac{1}{5}$ A.

FIG. 4.—Transverse section through the head, including the appendages. × $\frac{1}{5}$ A.

OGY OF LIMULUS.

FIG. 5.—Transverse section through the head, showing the invagination and thickening of the epiblast to form the brain; *my*, myeloid substance of the ganglion. × ⅕ A.

All the longitudinal sections are from the same egg, and the transverse sections from another. The figures were all drawn by the author with the camera.

—*A. S. Packard.*

PHYSIOLOGY.[1]

SCIENCE VS. THE "ZOÖPHILIST."—The believers in physiological experiment upon animals as a means for increasing our knowledge of the body will all heartily indorse Professor Martin in his vigorous "castigation" of the truth-distorting and fanatic *Zoöphilist*, an English sheet whose ostensible object is the prevention of cruelty toward animals. People who are opposed to what is popularly known as "vivisection," may be divided into two classes, the reasonable and the unreasonable. It is the duty of physiologists to maintain the respect of the former class by the presentation of the abundant arguments which defend the use of the lower animals, under proper conditions, for scientific purposes. The latter class could probably never be completely silenced except by a course of unresponsive contempt, but for all that one must occasionally be pleased to see a fool get his just deserts.

CONDITIONS MODIFYING THE DIASTATIC ACTION OF SALIVA.—Messrs. Chittenden and Smith have extended the valuable researches of the former upon the diastatic action of saliva. The following are their conclusions:

"1. The diastatic action of saliva can be taken as a definite measure of the amount of ferment present only when the dilution of the saliva in the digestive mixture is as 1 : 50 or 100. The limit of dilution at which decisive diastatic action will manifest itself with formation of reducing bodies is 1 : 2000–3000, under the conditions previously given. 2. The diastatic action of neutralized saliva is greater than that of normally alkaline saliva. The difference is particularly noticeable where the dilution is as 1 : 50 or 100, and is apparently out of all proportion to the amount of alkalinity. 3. Sodium carbonate retards the diastatic action of saliva in proportion to the amount of alkaline carbonate present. The percentage of alkaline carbonate, however, which hinders diastatic action can be designated only for definite mixtures and not in a general sense, being dependent on the dilution of the saliva and the consequent change in percentage of proteid matter. 4. The destructive action of sodium carbonate is materially modified by the dilution of the saliva, becoming greater the more the fluid is diluted. This result is due not to simple dilution but doubtless to the diminished amount of proteids. 5. Neutral peptone has a direct stimulating effect on the diastatic action

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Mich.

of neutral saliva. 6. The presence of small percentages of neutral peptone tends to raise the diastatic action of normally alkaline saliva to a point even beyond the action of the neutralized fluid; due in part doubtless to a loose combination of the alkali with the proteid matter, and also to a direct stimulation of the ferment. Likewise peptone tends to diminish in a similar manner the retarding action of the various percentages of sodium carbonate. To accomplish this, however, the amount of peptone must be proportionate to the percentage of alkaline carbonate. 7. Peptone tends to prevent the destructive action of dilute sodium carbonate on salivary ptyalin, thus giving proof of the probable formation of an alkaline-proteid body. 8. Saliva with its proteid matter saturated with acid appears to have a greater diastatic action than when simply neutralized; except when the acid proteids thus formed are above a certain percentage. Small percentages of peptone saturated with acid similarly increase the diastatic action of neutralized saliva up to a certain point. Increasing the percentage of acid-proteids finally causes a diminution of diastatic activity. 9. The retarding influence of acid-proteids is out of all proportion to their power of destruction. Large percentages, however, of acid-proteids may cause almost complete destruction of the ferment. 10. The most favorable condition for the diastatic action of ptyalin, under most circumstances, appears to be a neutral condition of the fluid together with the presence of more or less proteid matter. The addition of very small amounts of hydrochloric acid, however, to *dilute* solutions of saliva, giving thereby a *small percentage* of acid-proteids, appears to still further increase diastatic action. Under *such conditions* a minute trace of free acid appears to still further increase the action. 11. 0.003 per cent free hydrochloric acid almost completely stops the amylolytic action of ptyalin. The larger the amount of the saturated proteids the more pronounced becomes the retarding action of free acids. 12. The retarding action of the smaller percentages of free acid are not due wholly to destruction of the ferment. Pronounced destruction takes place with 0.005–0.010 per cent free hydrochloric acid. 13. Proteid matter, in influencing the diastatic action of salivary ptyalin, acts not only by combining with acids and alkalies, but apparently also by direct stimulation of the ferment."—*Trans. Conn. Acad., March, 1885.*

Physiology of the Sympathetic Nerves.—The generalization of Dr. Gaskell "On the relationship between the structure and the function of the nerves which innervate the visceral and vascular systems" are of the highest interest and importance. Dr. Gaskell calls attention to the fact that involuntary muscles, visceral and vascular as well as cardiac muscle, are supplied by two kinds of nerve fibers which are histologically distinct, the medullated

or white and the non-medullated or gray nerve fibers. Contraction of involuntary muscle is brought about exclusively by impulses proceeding along the non-medullated nerves, while relaxation or inhibition of muscular contraction is as invariably produced by impulses conducted by the medullated nerves. All nerves in their course from the spinal cord to the sympathetic ganglia are of the medullated variety, but on leaving the sympathetic ganglia they are separable into two groups of medullated and non-medullated fibers; the medullated sympathetic fibers are, however, easily distinguished from those of ordinary striated muscle by their smaller diameter.

Dr. Gaskell writes: "In previous communications I have shown that the heart of various cold blooded animals, *e. g.*, frog, tortoise, crocodile, is innervated by nerves coming from two distinct sources in the same way as the heart of the warm-blooded animal; and I am now enabled to make the further communication that in the dog, cat, rabbit, tortoise and crocodile these two sets of nerve fibers are structurally differentiated from each other in precisely the same manner. The vagus fibers from their origin up to their entrance into the heart are medullated, the sympathetic fibers in the whole of their course from the basal ganglia of the sympathetic along the annulus of Vieussens to the heart are non-medullated. * * * Every involuntary muscle is innervated by two nerves which are histologically and physiologically distinct; the one gray, non-medullated, causing contraction of the muscle; the other white, fine, medullated, causing relaxation of the muscle."—*Jl. of Physiology, Vol. vi, p. iv.*

ANTHROPOLOGY.[1]

THE AMERICAN ANTIQUARIAN.—This valued exchange has now become a bi-monthly. The anthropological papers of No. 5, Vol. VI, are:

Hindoo mythology. By F. G. Fleay.
Dates in the ancient history of S. America. By M. Castaing.
The hill tribes of India. John Avery.
Emblematic mounds. By S. D. Peet.

The paper of Mr. Avery is of great value, not only in naming and describing tribes, but in the explanation of certain customs. The article by the editor relates to the attitudes of the animals in the emblematic mounds, and supports the view that the constructors had in mind the various poses of the animals, which are familiar to hunters.

METALLURGY AMONG SAVAGES.—Dr. Richard Andree has just published in Leipzig a most interesting monograph with the following title: "Die Metalle bei den Naturvölkern mit berücksichtigung prähistorischer verhältnisse, mit 57 abbildungen im text.

[1] Edited by Professor OTIS T. MASON, National Museum, Washington, D. C.

Leipzig, Veit u. Comp., 1884," pp. 166. The topics treated are as follows:

Iron and copper among the Negro races.
Iron and copper in hither India.
The Gypsies as metal workers.
Metallurgy among the Malays, farther India, China, Japan, Northern Asia.
Knowledge of iron among the American Indians.
Copper in North America.
Copper and bronze in Mexico.
Metals used by the Chinchas.
Copper and bronze in Peru.
The spread of iron in the South Sea islands.

THE FRANKFURT CRANIOMETRIC AGREEMENT.—A full statement of this agreement has been published in the NATURALIST, and its importance is so great that we draw attention to Professor Garson's objections to it. In the first place, since those devoting themselves to any branch of science belong to one brotherhood, the introduction of the word German is unfortunate. In drawing up any code of craniometric measurements the researches of Broca must be the basis. Professor Garson advocates the condylo-alveolar plane. The audito-orbital plane is in some instances directed more or less obliquely downward; it is more difficult to place the skull in the latter plane; the apparatus of suspension is complicated and in the way of important measuring. Again, the horizontal measures are not important, the form of the skull is quite as fully indicated by measurements from fixed points by the sliding callipers. The following Frankfurt measurements are accepted, the numbers are those of the agreement:

2. Maximum length.
4. Maximum breadth.
5. Maximum frontal breadth.
7. Height (basio-bregmatic).
10. Basio-nasal length.
12. Length } of foramen magnum.
13. Breadth }
14. Horizontal circumference.
15. Fronto-occipital arc.
17*a*. Bi-jugal breadth.
18. Bi-zygomatic breadth.
18*a*. Inter-orbital breadth.
21. Height of nose.
22. Breadth of nose.
23. Orbital breadth.
25. Orbital height.
30. Basio-alveolar length.

The following measurements are rejected:

1. Horizontal length.
6. Total height.
8. Ear height.
9. Auxiliary ear-height.
11. Basilar length.
13*a*. Bi-mastoid width.
13*b*. Breadth of base of skull.
16. Transverse vertical arc.
17*b*. Infra-jugal facial breadth.
24. Maximum horizontal orbital breadth.
26. Vertical height of orbits.
27. Palatal length.
28. Palatal breadth.
29. Posterior palatine breadth.
31. Profile angle.

REVUE D'ANTHROPOLOGIE.—Numbers I and II for 1882 contain the following papers:

Description élémentaire des circonvolutions cérébrales de l'Homme, d'après le cerveau schematique. By Paul Broca and S. Pozzi.

Le Transformisme. Cours d'Anthropologie Zoologique de l'Ecole d'Anthropologie. By Mathias Duval.

Etudes sur les Populations primitives. Les Cafres et plus specialement les Zoulous. By M. Elie Reclus.

Le Poids du Cervelet, du Bulbe, de la Protuberance et des Hémispheres, d'après les registres de Broca. By Dr. Philippe Rey.

Etudes sur les Populations Primitives, etc. (fin.)

De l'Angle Zyphoïdien. By Adrien Charpy.

Etude sur les Kalmoucks (suite). By J. Denilar.

ETHNOGRAPHY OF GUATEMALA.—Dr. Otto Stoll, a resident physician in Guatemala, has undertaken to supplement the work of Brasseur and of Berendt on the comparative linguistics of the Central American States. There are eighteen languages now spoken in Guatemala, fourteen of them belonging to the Maya Qu'iché, viz., Maya, Mopan, Chol, Qu'ekchi, Pokonchi, Uspanteca, Ixil, Aquacateca, Mame, Qu'iché, Cakchiquel, Tzu'tuzil, Pokomam, Chorti. The Sinca, Pupuluca, Pipil and Carib represent other stocks. Dr. Stoll takes up his work in a very systematic manner, stock by stock, giving in each the tribes examined together with the literature, synonymy, chirography, history and vocabulary. Thus:

I. Aztek stock. The Pipils (Escuintla and Cuajiniquailapa).
Synonymy: Pipil (authors); Mejicano and Nahuate (Juarros); Nahual of the Balsam coast and of Izalco (Squier); Mexicanic or language of the Tlaskaltekas (Scherzer).

II. Mije stock. The Pupulucas (Cognaco, extreme south-east).
Synonymy: Pupuluca (Juarros; Populuca (Palacio); Popoluca (Berendt MSS.).
Papuluka (Brasseur) is the name of a Cakchiquel village, and Scherzus Papuluka Katschike is pure Cakchiquel.

III. Carib stock. The Caribs (Gulf of Honduras).

IV. The Maya-Qu'iché stock. 250 words in sixteen languages given.

Dr. Stoll divides the Maya into four groups:

A. Tzendal.
B. Pokonchí.
C. Qu'iché.
D. Mame.

A. Tzendal group. 1. Chontals of Tabasco.
Synonymy: Do not confound them with the "Chontales" of Nicaragua, who are entirely different.

2. Tzentales (Ocosingo).
Synonymy: Celdal (Cepeda).

3. Tzotziles (San Christobal de Chiapas).
Synonymy: Cinacanteca (Cepeda); Zotzlem (Brasseur) or Zotzil; Que!enes (Spanish historians).

4. Chañabal (Comitan, near north of Guatemala).

5. Choles (across Guatemala from Salinas r. to Motagua r., see p. 90).

Synonymy: Putum (Berendt); Cholti (Moran); Colchi (Palacio); Ecolchi (Alonzo de Escobar).

6. Mopanes (north of Chols in Guatemala).

B. Pochonchi group. 1. Qu'ekchis (east, west and north of Coban).

Synonymy: Cæchi (Palacio); Caichi (Juarros); Egkchi (Habel); Cakchi (Charencey); Vater confounds Cacchi with Qu'iché.

2. Pokonchis (around Tactic).

Synonymy: Spelled Poconchi, Pocomchi and Pokomchi. The Poconchi of Gage and Scherzer is Pokomam.

3. Pokomams (Guatemala to Jalapa and eastward).

Synonymy: Poconchi (Gage and Scherzer); Pokome (Charencey).

4. Chortis (Zacapa and Chequemula and eastward).

Synonymy: Lenguaapay (Palacio); Chol (Jimenez, by Brasseur).

C. Qu'iché group. 1. Qu'ichés (Cunen and Rabinal, south-west to Pacific).

Synonymy: Lengua Utatleca (authors) also Kiché.

2. Uspantaks (S. Miguel Uspantan).

3. Cakchiquels (Tecpam to Sta Lucia and to Pacific).

Synonymy: Lengua Achi (Fuentes, Palacio); Cuauhtemalteco ? (Palacio); Kacchikil (Vater); Chacciquel (Th. Gage); Pupuluka Katschikel (Scherzer); also Cakchiquelchi.

4. Tz'utujiles (around Atitlan).

Synonymy: Sotojil (Fuentes); also Zutuhil, Tzutohil.

D. Mame group. 1. Ixiles (Cotzal and vicinity).

2. Mames (all Southwestern Guatemala).

Synonymy: Zakloh pakap (Reynoso); Mem (authors).

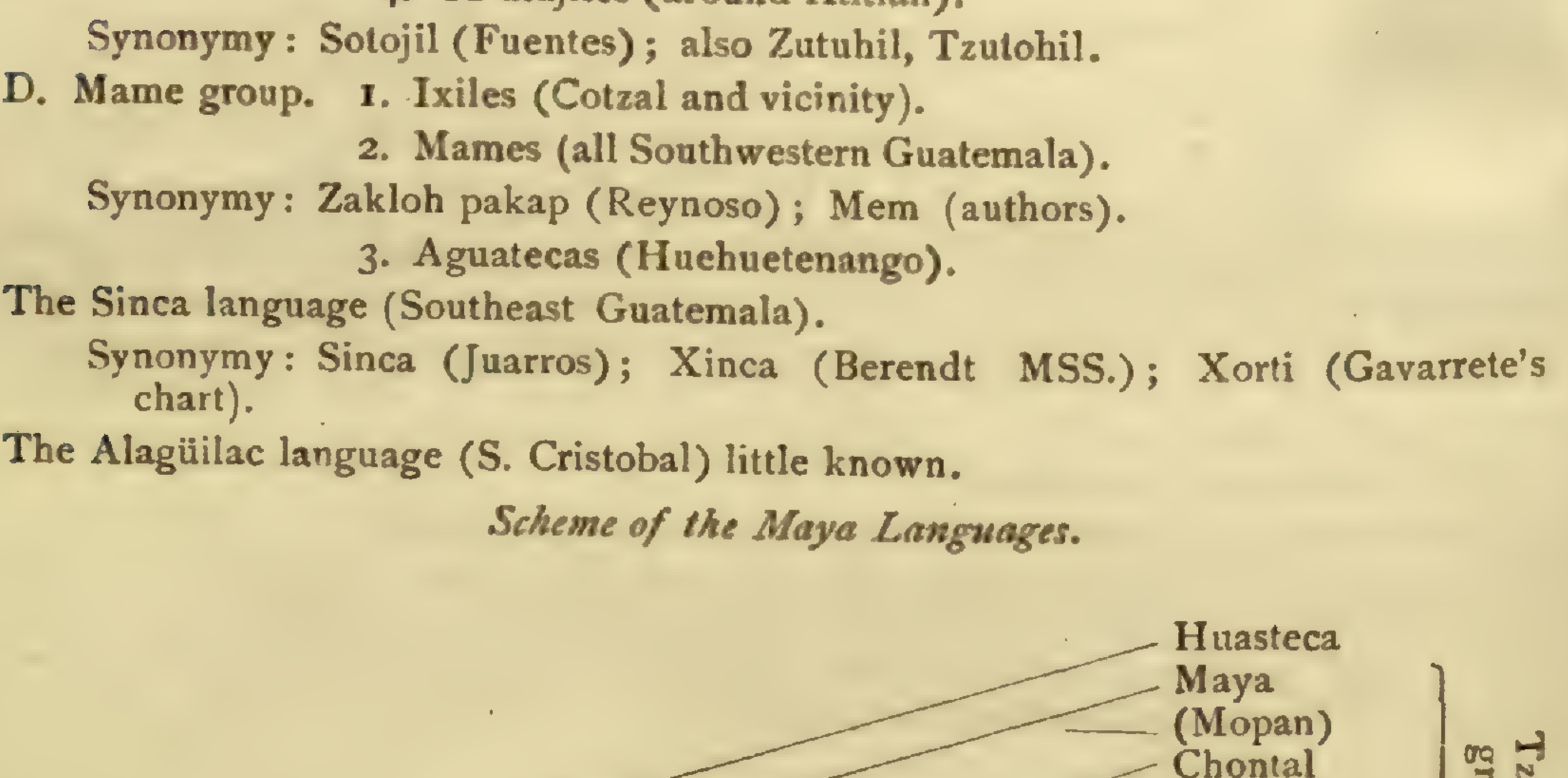
3. Aguatecas (Huehuetenango).

The Sinca language (Southeast Guatemala).

Synonymy: Sinca (Juarros); Xinca (Berendt MSS.); Xorti (Gavarrete's chart).

The Alagüilac language (S. Cristobal) little known.

Scheme of the Maya Languages.



While upon the Maya it is well to note that H. de Charencey continues his treatise on conjugation in the Maya-Qu'iché lan-

guages, in Le Muséon, Vol. III, 517–651; and Daniel G. Brinton publishes in the Proc. Am. Phil. Soc., No. 115, pp. 345–412, a grammar of the Cakchiquel language of Guatemala.

MICROSCOPY.[1]

MAYER'S CARBOLIC ACID SHELLAC.—Finding that clove oil and creosote produce fine granulations when used in the ordinary shellac method, Dr. Paul Mayer has adopted a new method of dissolving the shellac, by which an excellent fixative is obtained that never shows any traces of granulation. The fixative is applied by a fine brush to the *cold* slide.

Mayer prepares the solution in the following manner:

1. Dissolve one part of bleached shellac in five parts of absolute alcohol.

2. Filter the solution and evaporate the alcohol on a water-bath. A yellowish residue quite stiff when cold is thus obtained. If any cloudiness arises during evaporation, the solution must be filtered again.

3. Dissolve the shellac residue in pure carbolic acid on a water-bath. A concentrated solution of carbolic acid is obtained by exposing the crystals to the air until they dissolve, or by adding a small amount of water (about five per cent).

The quantity of acid should be sufficient to give a thickish liquid when cold.

This fixative is painted on to the cold slide with a brush, at the time of using. The sections are then placed, and the slide left in the oven of a water-bath for some minutes (10–15 minutes I find sufficient). The carbolic acid is thus evaporated, leaving a perfectly transparent stratum of shellac on the slide. The sections are next freed from paraffine in the ordinary way and mounted in balsam.

This method is considered to be the best and simplest for fixing *stained* sections.

The shellac can be dissolved directly in carbolic acid, but then the fluid must stand a long time in order to become clear, as it cannot be filtered. For this reason it is preferable to dissolve first in alcohol.

NOTE.—According to a note just received, Mayer now prepares the shellac as follows:

The shellac is pulverized and heated with crystals of colorless carbolic acid until it dissolves. In filtering the funnel should be heated over a flame. It will filter slowly but quite well. If it is too thick crystals of carbolic acid may be added until the desired consistency is reached.

AN ETHER FREEZING APPARATUS.[2]—A very simple and convenient little freezing apparatus, which can be used with almost any microtome, has recently been described by W. Emil Bœcker.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.
[2] Zeitschr. f. Instrumentenkunde. Apr., 1884, pp. 126–127.

Following the principle of the Lewes and the Ray[1] instruments, the ether spray is thrown on the under side of the object-plate instead of on the object itself.

The apparatus consists of a short cylinder (Fig. 1 *A*), closed by the plate, *P*, on which the object is placed for freezing. A metallic tube (*a*) drawn to a fine point penetrates the base of the cylinder, and another (*b*) its side. The vertical tube (*a*) is connected by rubber tubing with a small bellows, while the horizontal tube (*b*) is similarly connected with a glass tube which passes through the stopper of a bottle containing ether, reaching nearly to the bottom. When the bellows is set in motion the current of

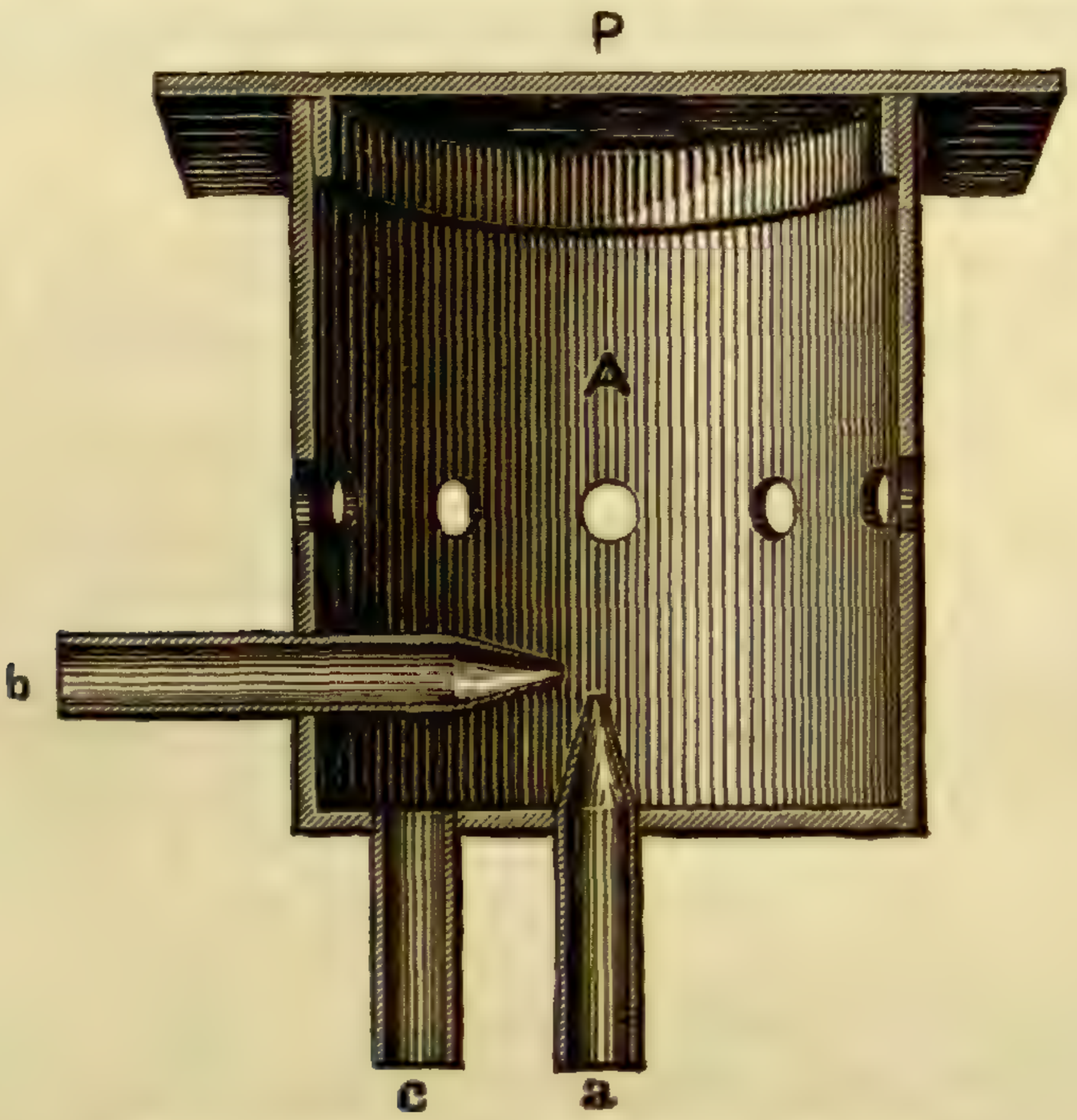


FIG. 1.—Freezing cylinder seen in section.

air throws the ether spray against the plate, *P*, and the rapid evaporation thus produced soon lowers the temperature sufficiently to freeze the object. The ether vapor and the air escape through a series of holes in the side of the cylinder. A third tube (*c*) connects with a second glass tube that extends barely through the stopper of the bottle of ether, and thus provides for the admission of air into the bottle and for the escape of the excess of condensed ether.

The cylinder is small enough to be received by the holder of the microtome. It is to be obtained from W. Emil Boecker, in Wetzlar, Germany, at sixteen and a half marks ($4.25).

The Roy microtome, referred to above, is made by Schaure, Pathologische Institut, Liebig-Strasse, Leipzig.

A NEW FREEZING MICROTOME.—Dr. F. O. Jacobs, of Newark, O., has devised the freezing microtome shown in Figs. 1 and 2.

[1] Arch. f. mikr. Anat., XIX, pp. 137–143, Pl. VI, 1880.

It consists of a copper rod, *A*, two inches or more in diameter and six inches high, inclosed by an inner zinc (*b*) and an outer brass tank (*c*). Above is the table, *D*, working on a fine screw (*d*). Through the center of the table passes a narrower portion of the copper rod, the piston (*p*).

When the inner tank is filled with a mixture of salt, ice and water, the temperature of the copper rod is so reduced as to

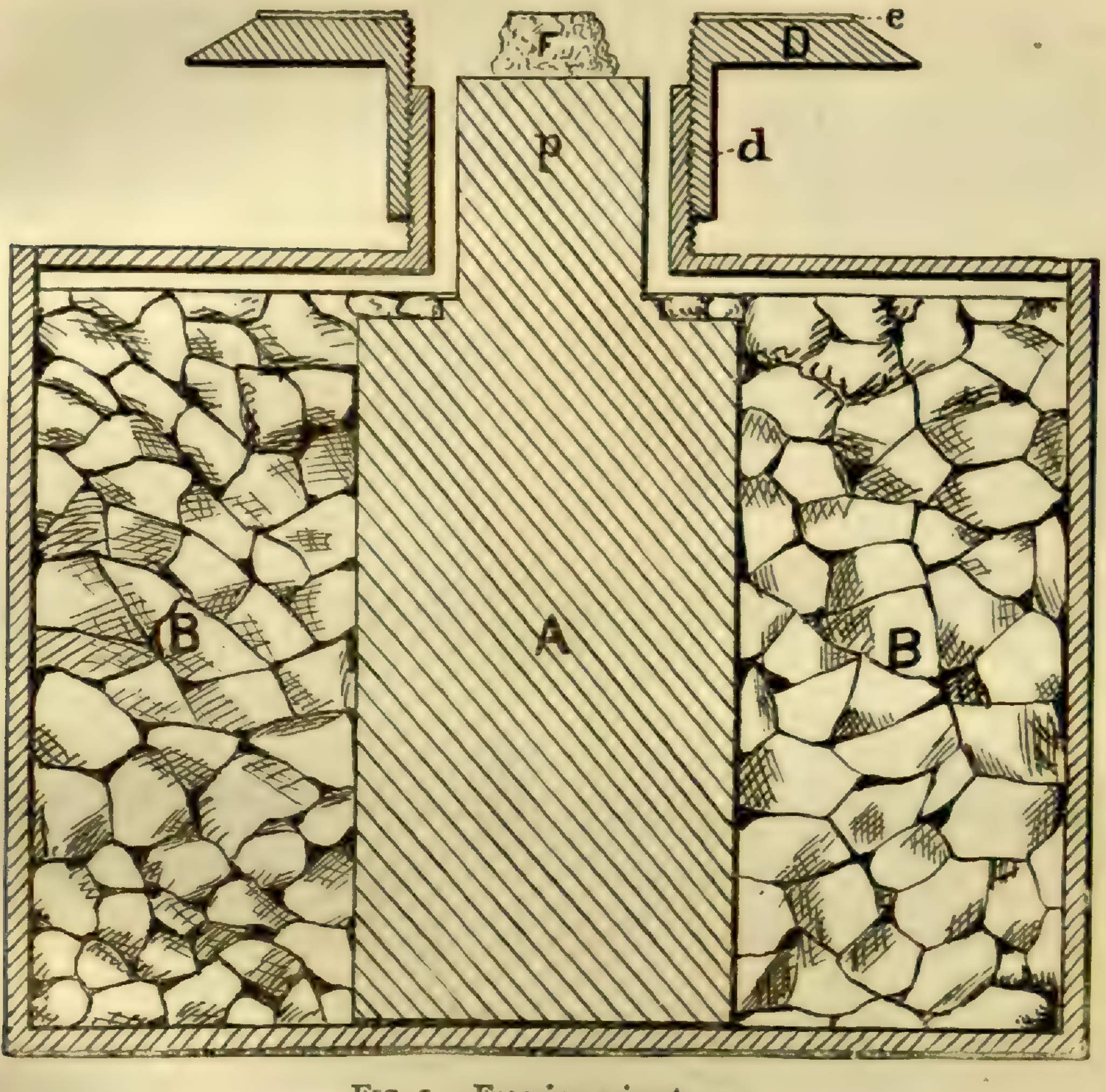


FIG. 1.—Freezing microtome.

freeze any object (*F*) placed on its upper end. The size of the rod is such that its temperature will remain very steady for from four to six hours without any further care on the part of the operator.

By this arrangement, the advantages of which will be readily seen, objects can be easily frozen, and without any slop or "muss."

The imbedding medium is composed of:

Gum arabic	5 parts.
Gum tragacanth	1 "
Gelatine	1 "

The mixture is dissolved in enough warm water to give it the

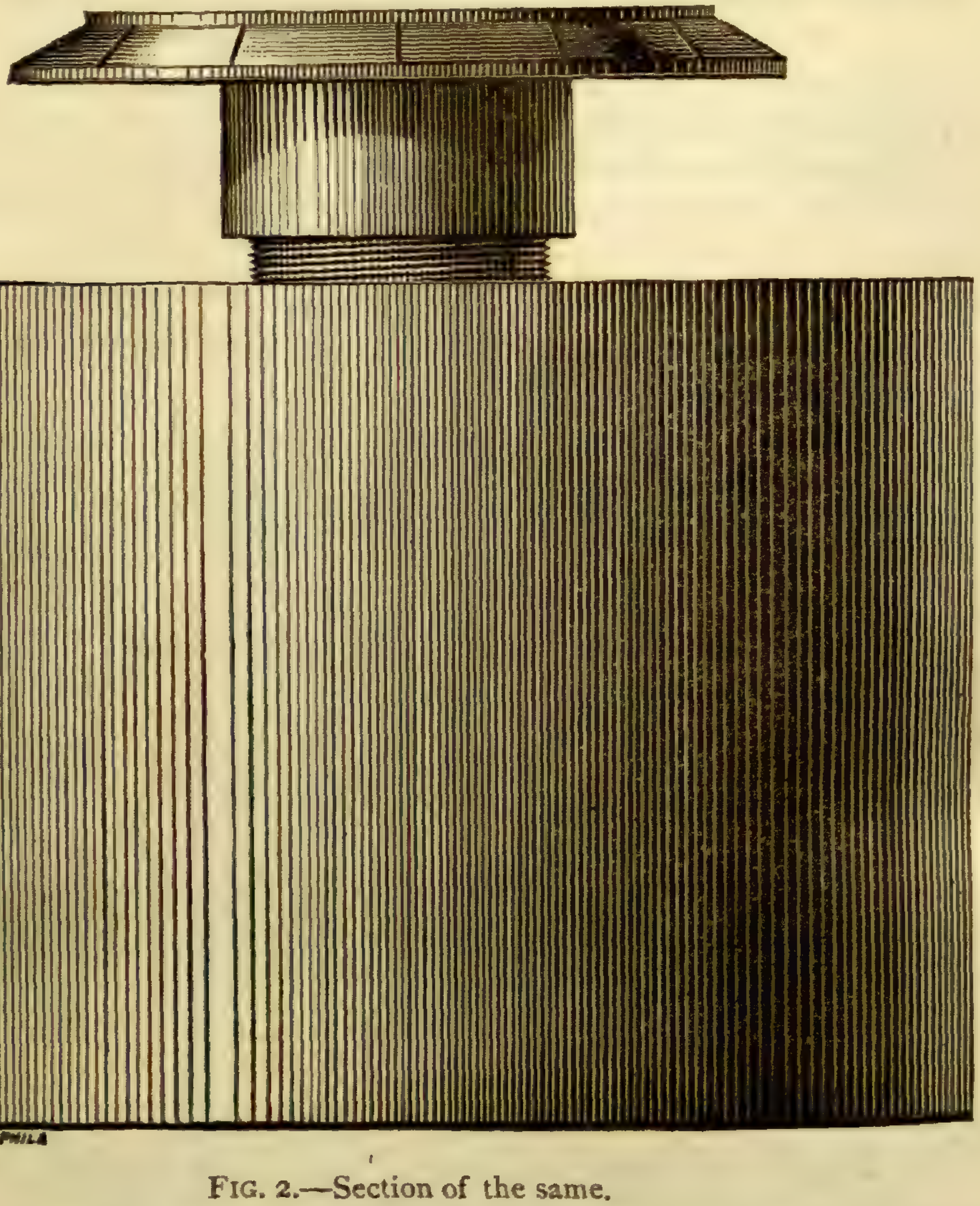


FIG. 2.—Section of the same.

consistency of thin jelly when cold. A little glycerine (1 : 6) is added to the water.

——:o:——

SCIENTIFIC NEWS.

— Under the title "Elephant pipes in the museum of the Academy of Natural Science, Davenport, Iowa," Mr. Charles E. Putnam enters a vigorous and well written protest against the criticisms and insinuations which have been made against the character of the discoverer and the authenticity of the elephant pipes in the museum of the Davenport Academy. The article is racy reading, and incidentally gives strong arguments against the desire for centralization in science shown in certain quarters. It will be found impossible to concentrate all science in any one clique or city. Our local societies and scattered observers need not feel that their efforts are not as valuable in their way as the labors of government officials and closet or office naturalists.

— The Bulletin of the Natural History Society of New Brunswick, No. IV, contains the following papers: A preliminary list of the plants of New Brunswick, by James Fowler; The surface geology of Fredericton, N. B., by W. T. L. Reed; The invertebrates of Passamaquoddy bay, by W. F. Ganong; the more valuable being Mr. G. F. Matthews' on recent discoveries in the Saint John group, with a letter from Professor A. Hyatt.

— Among recent works on fishes which have appeared in Europe are the second and third parts of Professor Lilljeborg's "Swedish and Norwegian Fishes," prepared in the same thorough manner as his late work on Scandinavian mammals. From William Sörensen we have received an important physiological and anatomical treatise on the organs of hearing in fishes, a book of 245 pages with four excellent plates. The Dipnoi have been studied anatomically and physiologically by Howard Ayres, Ph.D., whose memoir appears in the Jena Zeitschrift, and is illustrated by numerous figures.

— The annual meeting of the American Society of Microscopists will be held in Cleveland, Ohio, Aug. 18–21, 1885, and while of especial interest to microscopists is of interest to students in every departmont of science. The working session, in which the most approved and original methods of microscopical investigation will be practically demonstrated by leading experts, will be of value to all working naturalists and students.

— The lectures on natural history now being delivered to the school teachers of the city of New York, by Professor A. S. Bickmore, have, as we personally know, proved a decided success, both in point of numbers and interest manifested both in the lectures and exhibitions of specimens to the audience in the work-rooms of the American museum at Central park.

— The next meeting of the American Association for the Advancement of Science will be held at Ann Arbor, Mich., beginning Aug. 26, 1885. The Entomological Club will meet at that place Aug. 25th.

— The British Association will meet at Aberdeen, Sept. 9th. The president is Sir J. W. Dawson; the president elect, Right Hon. Sir Lyon Playfair, K.C.B.

— The French Association for the Advancement of Science will meet this year at Grenoble, on Aug. 13, under the presidency of Professor Verneuil.

— *Errata.*—Page 608, line 14, for he *read* we.
" 608, " 33, " Fregana *read* Freyana.
" 609, " 17, " sub-lined *read* six-lined.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, May 16.—Communications: Mr. Frederick W. True, Exhibition of a specimen of the Guefeza monkey, *Colobus guereza;* Dr. Tarleton H. Bean, Note on a new fish from Florida, allied to Murænoides; Mr. J. L. Wortman, On the reduction of the molar teeth of the Carnivora; Professor Otis T. Mason, On post-mortem trepanning; Mr. Lester F. Ward, Some Cretaceous fossil plants from the Laramie group.

May 30.—Mr. Lester F. Ward, Recent flowering of the Ginkgo tree in Washington, with remarks on the phylogeny of the genus; Dr. H. G. Beyer, U.S.N., The physiological effects of cocaine; Dr. C. V. Riley, Notes on the periodical Cicada; Col. Marshall McDonald, A theory to xplain the phenomenal abundance of migratory fishes in certain seasons; Dr. Thomas Taylor, How to distinguish between animal and vegetable fats.

NEW YORK ACADEMY OF SCIENCES, May 11.—The following paper was presented: The geology of the Bermuda islands, by Mr. James F. Kemp, E.M.

May 18.—The last public lecture of the free monthly course was given by Professor Daniel C. Eaton, on Hybrids and hybridism.

June 1.—Mr. William E. Hidden described the minerals of special interest at the New Orleans exhibition..

BOSTON SOCIETY OF NATURAL HISTORY, May 20.—Mr. George H. Barton described the ancient land-system of the Hawaiians; Dr. C. S. Minot discussed the causes limiting the duration of organic life.

AMERICAN PHILOSOPHICAL SOCIETY, Feb. 20, 1885.—Mr. Philips exhibited and gave an account of a "writing box" presented in 1785.

March 20.—Dr. Brinton read a paper on the Philosophic grammar of American languages as set forth by Humboldt, and also a paper by Dr. H. Rink on Danish explorations in Greenland and their significance; Dr. Greene presented a paper, by Dr. O. C. S. Carter, On the adulteration of oils.

April 21.—Professor Cope presented a communication on Some points in Mexican geology and zoölogy, and also a paper on some new Eocene Vertebrata; Professor F. A. Genth presented a paper on the Vanadites and iodyrites found in Lake valley, Sierra county, Cal.; Mr. W. Taylor presented a paper on the method of making composite photographs on the Galton plan, illustrating his subject with photographs; and Professor Chase sent a proof sheet entitled, "Further experiments in weather forecast, also a paper on the Chase-Maxwell ratio."

May 1.—Dr. H. Allen made a communication on The tarsus of bats.

PLATE XXV.

Interior view of palate and both jaws of left side of the fossil man of Mexico.
From a photograph of the original by Cruces y. Ca.

THE
AMERICAN NATURALIST.

VOL. XIX.—*AUGUST*, 1885.—No. 8.

NOTICE OF SOME HUMAN REMAINS FOUND NEAR THE CITY OF MEXICO.

BY MARIANO DE LA BARCENA.

IN the month of January, 1884, some excavations were being made, by means of dynamite, at the foot of the small hill known as "*Peñon de los Baños*," some four kilometers east of the City of Mexico. The excavations were made with the object of quarrying building stone for the Military Shooting School which is being constructed near the Peñon and under the supervision of Colonel Don Adolfo Obregon. This gentleman, at the beginning of January, was informed that among the rocks loosened by the dynamite some bones were to be found, and he accordingly collected and delivered them to the Minister of Public Works, Don Cárlos Pacheco, who appointed the writer to make a study of them. The preliminary examination being made, I presented them to the Mexican Society of Natural History, giving at the same time public notice of so important a discovery.

Some days afterwards I explored the formation in which the bones were found, continuing my studies with the coöperation of Don Antonio del Castillo, professor of geology, whom I invited to take part in my investigations; both making up a report which has lately been published in Mexico.

The human remains are firmly imbedded in a rock formed of silicified calcareous tufa, very hard and of a brownish-gray color. The cranium with the lower and upper maxillæ and fragments of the collar-bone, vertebræ, ribs and bones from the upper and lower limbs are exposed. The bones lie in disorder, proving that the rock in which the skeleton was found suffered an up-

heaval before consolidation, a circumstance which an examination of the ground further verifies. The bones present a yellowish appearance and the characteristic aspects of fossilization, it being noteworthy that they are not coated with layers of the calcareous rock as is observed in the recent deposits, but are firmly imbedded in the stone, which also fills the cells of the tissue.

Several distinct formations and rocks are seen in the locality where the bones were found; towards the center rises the small hill "*del Peñon*," consisting of volcanic porphyries; on the base to the north there appear first a clearly recent formation made up of vegetable earth, marl and ceramical remains, which in the upper part are modern, and in the lower belong to the Aztec ceramics. Under this recent formation are the calcareous layers in which the human remains were found.

These layers crop out with a rise toward the northern boundary, forming the end of an esplanade which surrounds the hill, and is three meters above the actual level of the waters of Lake Tezcoco. The layer of hardened rock does not extend with regularity the whole distance from the before-mentioned edge to the foot of the hill, some intervening spaces occurring in which this rock does not appear; the resulting hollows being filled with recent ground. This circumstance as well as the appearance of the layers of calcareous tufa, prove that this rock was upheaved after the deposit of the human bones, by the igneous rocks which crop out in the neighborhood of the hill forming dykes. This upheaval is also verified by the numerous smalls veins which are found in different directions on the ground.

In order to clearly establish the age which the deposit of the human bones might have, the best scientific method would be to find some animal fossil remains in the same formation which would distinctly mark the age of the layers of that calcareous rock, but until now, notwithstanding the many searches made, it has not yet been possible to find any traces of extinct animals; neither has there been found any vestige of ceramics or other remains that might indicate that these rocks were clearly modern, as among them the only things found were the human bones, roots converted into menilite and some small indeterminable lacustrine shells formed by the same calcareous substance. These shells belong to genera which have lived in Quaternary as well as present waters, it having been impossible to determine their species

on account of the bad state of preservation in which they were found.

In the region to the south of the hill more modern calcareous rocks are seen, and thicker deposits of recent ground with remains of Aztec ceramics.

Not being therefore able to utilize the palæontological data for determining the age of these calcareous layers, we must fall back on the inspection of the ground.

Two facts seem at once to reveal that even supposing the formation to belong to the present age, it must be of remote antiquity. These facts are: The elevation of the ground above the actual level of the Lake of Tezcoco, and the remarkable hardness of the rock in which the bones are found, different from the other calcareous rocks that contain remains of ceramics or roots of plants clearly modern. The upheaval of the lacustrine layers which contain the human remains might have taken place through the diminution and retirement of the waters of the lake, or by the upheaval of volcanic rocks.

In the first case it could have been occasioned either by a violent filtration of the water, or a slow evaporation; but nowhere in the valley of Mexico are any traces to be found of a crack or opening through which the waters could have escaped, and which ought to appear outside of the present level of the lake, as if it were below, all the water would have disappeared. If the lowering of level was due to evaporation, a theory which would be more admissible, because from the time of the conquest of Mexico to the present the submerged surfaces have notably diminished, the time necessary to have elapsed in order that the level of the lake might fall three meters to its present one, must have been very long. What is most probable is, that the upheaval is due to volcanic action; for although until now no basalt has been discovered immediately underneath the place occupied by the hardened layers, yet dikes of that rock are to be seen in different directions at the foot of the hill, and even the volcanic masses which constitute it are found upheaved and inclined, demonstrating the succession of geological phenomena in that vicinity.

Let us now trace the origin of the silicified calcareous rock in which the bones were found, and which is different from the majority of the lacustrine rocks which occupy the valley of Mexico, these latter being, for the most part, thick and extensive

layers of pumice, tufas, marls, volcanic ashes, clays and alluvions.

In order to proceed with more certainty in this investigation, I compared the calcareous rock in question with those which resembled it most from other parts of Mexico, and found it could only be considered similar to those which are clearly of a hydrothermal origin.

The hot-water spring which exists in the eastern part of the hill del Peñon forms sediments somewhat similar to the silicified calcareous tufa; but these are on a small scale and their formation is so slow as to preclude the belief that this spring could have filled all the immediate surroundings of the hill with deposits of such magnitude. What is most probable is, that in remote times there were great emissions of mineral thermal waters through different fissures, and in several directions, whose appearance was simultaneous with the basaltic masses that form dikes at the foot of the hill, as in the faces of the rocks sedimentations similar to the referred ones are perceived, there being furthermore many small veins which cut through the basaltic masses and even the calcareous rock.

By this it is seen that a series of volcanic phenomena must have taken place in that spot, beginning before the human remains were deposited, and which further continued when the material which received them was but little consolidated.

The succession of these phenomena took place, without doubt, in the following way:

1st. Emission of thermal waters and appearance of basaltic rocks, upheaving the masses that formed the hill. These waters mixed with those of the lake which surrounded the hill and extended over a large area of the valley of Mexico; the calcareous deposits gradually accumulated around the hill, and being still soft the human corpse was deposited upon them.

2d. When the bones were already imbedded in the lacustrine deposit there came a new volcanic upheaval which raised this deposit, as the higher level which it now occupies proves, and the disorder in which the bones of the skeleton appear.

3d. In the gaps which were left after this upheaval, modern lacustrine deposits were formed, which increase even at the present time.

It is to be remarked that in other parts of the valley of Mex-

PLATE XXVI.

External view of left side and front of jaws of the fossil man of Mexico. From a photograph of the original by Cruces y Ca.

ico in connection with the Lake of Tezcoco, isolated deposits of this silicified calcareous rock are seen, showing that the volcanic upheaval extended over a large surface, and that the thermal waters appeared several times. One of these deposits is to be found at the height of two meters above the present ground among rocks of the hill *del Tepeyac*, north of the City of Mexico.

The geological circumstances of the event once determined, and notwithstanding that the palæontological data are wanting that might mark with precision the relative age of that deposit, it is to be believed that it must be of remote antiquity, considering the circumstances which the mentioned rocks present, as well as the geological phenomena which have there taken place and of which no notice is given in the hieroglyphics or traditions of the ancient Mexicans.

This consideration alone is enough to believe that the man of the Peñon is prehistoric The odontological characteristics indicate that this man belonged to an unmixed race, the teeth being set with regularity and corresponding perfectly the upper with the lower. They present the peculiarity besides, that the canine teeth are not conical, but have the same shape as the incisors; a peculiarity which has been observed in other teeth found in very ancient graves of the Toltecs.

The size and shape of the bones of the limbs are those corresponding to a man of ordinary stature, and from the appearance of the teeth the man must have been about forty years old.

The greater part of the cranium having been destroyed, it was not possible to determine its diameters and thus classify it. The stratigraphical and lithological characteristics of the ground seem to indicate that the formation belongs to the upper Quaternary or at least to the base of the present geological age.

It may as well be remarked that at the foot of the steep slope of the Tepeyac hill, near the place where the calcareous sediments are to be seen among the rocks of the hill, as was previously mentioned, some excavations were made, and Professor Don Antonio del Castillo found various bones of Quaternary animals enveloped in a calcareous rock similar to that of the Peñon. The distance between this hill and the Tepeyac is nearly three miles.

The excavations continue at the foot of the hill del Peñon, with

the object of quarrying building stone, and this will allow in the course of time some other data to be discovered which will clearly mark the geological age of the event; a tooth of a mastodon or an object of the present age would at once be the landmark assigning it a fixed page in the history of the earth. The authenticity of the fossil is not only determined by the report of Señor Obregon and the identity of the rock which contains the remains with the blocks that are being at present quarried at the foot of the hill, but I, myself, have determined this authenticity, having found part of the human remains still imbedded in the ground rock.

I will conclude by mentioning other facts that indicate the antiquity of man in the valley of Mexico. Twelve years ago, in executing some works for the drainage of the valley, in the direction of Tequisquiac, numerous deposits were discovered belonging to Quaternary animals, such as elephants, mastodons, glyptodons, etc., and among one of these deposits a fossil bone was found carved by human hand and imitating an animal's head. Unfortunately no care was taken to determine if it was found simultaneously with the bones of the Quaternary animals. The appearance of the carved bone and of the cuts and incisions which it has, denote a remarkable antiquity, and it has characteristics of fossilization. Two years ago I discovered some remains of ancient ceramics in the pumice tufa which is under the basaltic lava formation found in the south-eastern part of the valley of Mexico; the lava occupies a large area, and in some points its thickness is over two meters. No tradition makes any mention of this volcanic cataclysm before the existence of man in the valley of Mexico.

These are, at present, all the data I can give relative to the man del Peñon. On my return to Mexico I will continue with a further investigation of the ground where the discovery was made, and will communicate anything new that may be found, in order to determine the anthropological importance which these human remains may have.

EVOLUTION IN THE VEGETABLE KINGDOM.

BY LESTER F. WARD, A.M.

(Continued from p. 644, July number.)

II. Geological View.

The most ancient fossil remains that have been referred to the vegetable kingdom are two species of Oldhamia from the Cambrian deposits of Ireland, but the vegetable character of these forms has been latterly called in question. From the Lower Silurian forty-four species, chiefly marine algæ, have been named. Among these, however, are included the earliest terrestrial forms. Not to mention the problematical *Eopteris morierei* of Saporta, we have *Sphenophyllum primævum* Lx., and two other vascular plants from the Cincinnati group. In the Upper Silurian thirteen species are recorded, five of which are vascular plants. One of these is *Cordaites robbii* Dawson, found in the Silurian of Hérault as well as in the Devonian of Canada. The Devonian furnishes 188 species of fossil plants, while from the Permo-Carboniferous nearly two thousand species are known, or nearly nine-tenths of the entire Palæozoic flora.

With the Mesozoic a great diminution appears in the abundance of vegetable life that has been preserved. Only sixty-seven species have been found in the whole of the Trias. With the Rhætic a new impulse is felt increasing through the Lias and reaching a second but much reduced maximum in the Oölite, from which 419 species are recorded. The wave then again recedes until the close of the Gault is reached.

The Cenomanian of Europe, with the beds of Atane in Greenland and the Dakota group of the United States which probably correspond to it, mark a new epoch, supplying together nearly five hundred species of fossil plants. That member of the Cretaceous formation which immediately overlies the Cenomanian, viz., the Turonian, to which the Fort Benton group of American rocks seems to belong, is almost destitute in both countries of vegetable remains, but with the Senonian we meet again the increasing volume which was merely interrupted by unfavorable conditions for the preservation of plants. Here we have in European strata, in Patoot, Greenland, and in British Columbia 354 species. Although none have yet been described from this horizon within the territory of the United States, I have myself demonstrated

their existence to a limited extent, and live in hopes of yet bringing to light an important Upper Cretaceous flora.

We are thus brought to the Laramie group of the Western Territories, which, though a brackish water deposit and difficult to correlate with other deposits, may be regarded as extreme Upper Cretaceous; 333 species have been thus far described from this group, which presents a flora of a still more Tertiary aspect than that of the Senonian proper, and fittingly ushers in the Tertiary flora.

From the Paleocene of Sézanne and Gelinden to the Miocene the progress is uniform and rapid. The Eocene of the old world (Paris basin, Aix in Provence, Monte Bolca, Monte Promina, Monte Pastello, Isle of Wight, London clay, etc.) furnishes over 650 species, while the Green River group of America, including the rich beds of Florissant, Colorado, probably of that age, has yielded more than two hundred. This is exclusive of the so-called Oligocene of the continent (Hæring in Tyrol, Sotzka in Carniola, the Marseilles basin, Armissan near Narbonne, etc.) from which nearly 800 more have been taken. We thus have over 1800 pre-Miocene Tertiary plants, which is, however, much less than half of the Tertiary flora. The Miocene supplies nearly all the rest, yielding alone over 3000 species. It may be, as has been charged, that this number is too great, and that a portion of these plants belong to lower horizons. While Heer's determinations in Switzerland have not been seriously questioned, his work on the arctic floras is doubtless open to revision, but this will not diminish the number of Tertiary plants, which, if we add to those already mentioned some 150 Pliocene species, will form an aggregate of nearly 5000.

The Tertiary virtually closes the series for vegetable remains, the Quaternary having thus far furnished less than one hundred species of fossil plants.

The development of plant life through the successive geologic ages may be graphically represented, so far as indicated by actual discovery, by the accompanying diagram or figure, in which the number of accredited species is taken as a measure of predominance, and the space assigned to each horizon in the vertical scale represents its duration in so far as the thickness of the deposits can be regarded as a measure of time.

Quaternary.

Plio-miocene.

Eocene.

Cretaceous.

Jura-triassic.

Permo-carboniferous.

Devonian.

Silurian.

Cambrian.

The fact is thus brought clearly to view that there have existed

two favorable periods for the preservation of vegetable remains —the Carboniferous and the Miocene—the wide interval between which is relieved by two less favorable periods culminating in the Oölite and the Cenomanian respectively. To what extent the intervals of great scarcity may yet be filled, it is impossible to predict, but it is well to remember that it is only quite recently that the Oölite has assumed prominence as a vegetable deposit, and this chiefly through researches made in India and Siberia. With the further development of such outlying regions it is to be hoped that a much greater degree of uniformity in the different geological periods will be secured. But of this there is no certainty, and it is perhaps equally probable that future research may tend to exaggerate the present extremes.

Three things must combine for the successful development of a fossil flora in any given geological formation: 1. The requisite vegetation must have flourished at the period in question; 2. the conditions for its preservation and subsequent exposure must have existed; and 3. the localities in which it is imbedded must be found and worked. As regards the first of these conditions, we know that great fluctuations of the land surface of the globe have taken place, and periods may have been passed during which these were much less in amount than at others. Still, there can be little doubt that the variety at least, if not the abundance of vegetation, has undergone a somewhat uninterrupted increase since the earliest times. The second condition is a much more serious one. Immense periods may have elapsed without any record being made, not because vegetation was scarce, nor because land areas were limited, but because, as seems now to be the case over most of the globe, all vegetation was allowed to decay and return to the atmosphere. Again, vast beds may have been deposited but never afterward raised up and exposed, and may remain forever inaccessible. It is only the third condition which it is within the power of man to influence. But when we consider the accidental manner in which a great part of such discoveries have been made thus far, we may well presume that the most precious scientific treasures which the earth holds may remain undiscovered indefinitely although within the easy reach of the investigator.

III. Botanical View.

Most of the plants of the Palæozoic age belong to archaic types long since extinct and having only very much modified

living representatives. This is less marked in the ferns than in those forms which have as their nearest modern descendants the Equisetaceæ, the Lycopodiaceæ and the Coniferæ. The Palæozoic ancestors of the Equisetaceæ are the Calamariæ, having the genus Calamites for their typical form. Those of the Lycopodiaceæ are the Lepidophytes with Lepidodendron as their type, while according to the most recent researches the Coniferæ had as their ancestral form the Cordaiteæ, long classed among the Cycadaceæ, with Cordaites as the principal genus.

As a means of expressing the fact of this prolongation of living forms through the geologic periods and of denoting the probable descent of modern from these archaic types of vegetation, the terms Filicineæ, Equisetineæ and Lycopodineæ have been employed as broader than the corresponding ordinal designations in common use. The Marquis Saporta has sought to accomplish the same object for the Coniferæ by the term Acicularіæ, but this unfamiliar substitute will not be likely to meet with general acceptance.

The cellular cryptogams, which, admitting Oldhamia to be a plant, had two representatives in the Cambrian, constituted the principal vegetation throughout the Silurian. Yet the ferns, if we accept Saporta's Eopteris, the Equisetineæ and Lycopodineæ, all had their origin in the Lower Silurian, while the Coniferæ, through Cordaites, made their appearance in the Upper Silurian.

Three species of Rhizocarpeæ (Sporangites, Protosalvinia) have been described by Sir J. W. Dawson from spore-cases detected in Devonian rocks of both Canada and Brazil. Heer had already mentioned, in 1874, what he regarded as the fruit of some rhizocarp from the Lower Carboniferous of Spitzbergen, and there can be little doubt that many of the spore-bearing plants of the coal measures belonged to this order, although none have been described from the Carboniferous proper. This little group, which has been supposed in a manner to mark the transition from the cryptogams to the gymnosperms, reappears, according to Heer, in the Oölite of Siberia, the Urgonian of Kome and the Cenomanian of Atane, Greenland. It occurs in our Laramie and Green River groups, in the Oligocene of France, and in the Miocene of Switzerland and Central Europe.

With the true Carboniferous two new types appear—the Cycadaceæ and the monocotyledons. If, with Grand'Eury, we rele-

gate the Medullosæ to the ferns, the former of these types has a meager representation, but Renault admits Cycadoxylon in that formation, and *Cyclocladia ornata* occurs at Saarbrücken, while Schenk finds a true Pterophyllum in the coal flora of China.

The presence of monocotyledons in the Carboniferous was long disputed, based as it was upon certain palm-like trunks described by Corda from Radnitz. But we now have one species of Palæospathe whose monocotyledonous character has not been questioned. The problematical sporangium, too, formerly supposed to occur no lower than the Permian, has now been found in the Carboniferous of St. Etienne, of Wettin, of Mazon creek, Illinois, and of Pittston, Pennsylvania, while so skeptical an author as Nathorst, in one of his latest works, defends its claims to be called a monocotyledon.

Thus we find that all the leading groups or types of vegetation, except the dicotyledons, had made their appearance at the close of the Carboniferous age. Before passing to that important subclass of the vegetable kingdom, the Ligulatæ and the Gnetaceæ, though numerically unimportant, deserve notice because they have been regarded by some as transition forms connecting the great types.

The Ligulatæ are allied to the Lycopodiaceæ, and the genus Selaginella has sometimes been placed in the one and sometimes in the other of these orders. It is claimed to have been found in the Carboniferous, but of this there is doubt. Its first certain appearance is in the Cenomanian beds of Atane, Greenland, but it also occurs in our Laramie group at Golden, Colorado, and at Point of Rocks station in Wyoming Territory. The more typical ligulate genus, Isoetes, makes its first appearance in our Eocene at Florissant, Colorado, and is represented by two Miocene species in Europe.

As regards the Gnetaceæ, by far the most ancient known representative is Heer's *Ephedrites antiquus*, from the Oölite of Siberia. Only two other fossil species of this order are known, viz., *Ephedra (Ephedrites) sotzkiana* (which not only occurs in the Oligocene of Sotzka, but in several of the principal Miocene beds of Switzerland, Germany and Austria) and *Ephedra johniana* from the amber deposits of Samland, Prussia.

The immense interval of time that separates the first appearance of all other forms of plant life from that of the dicotyledons

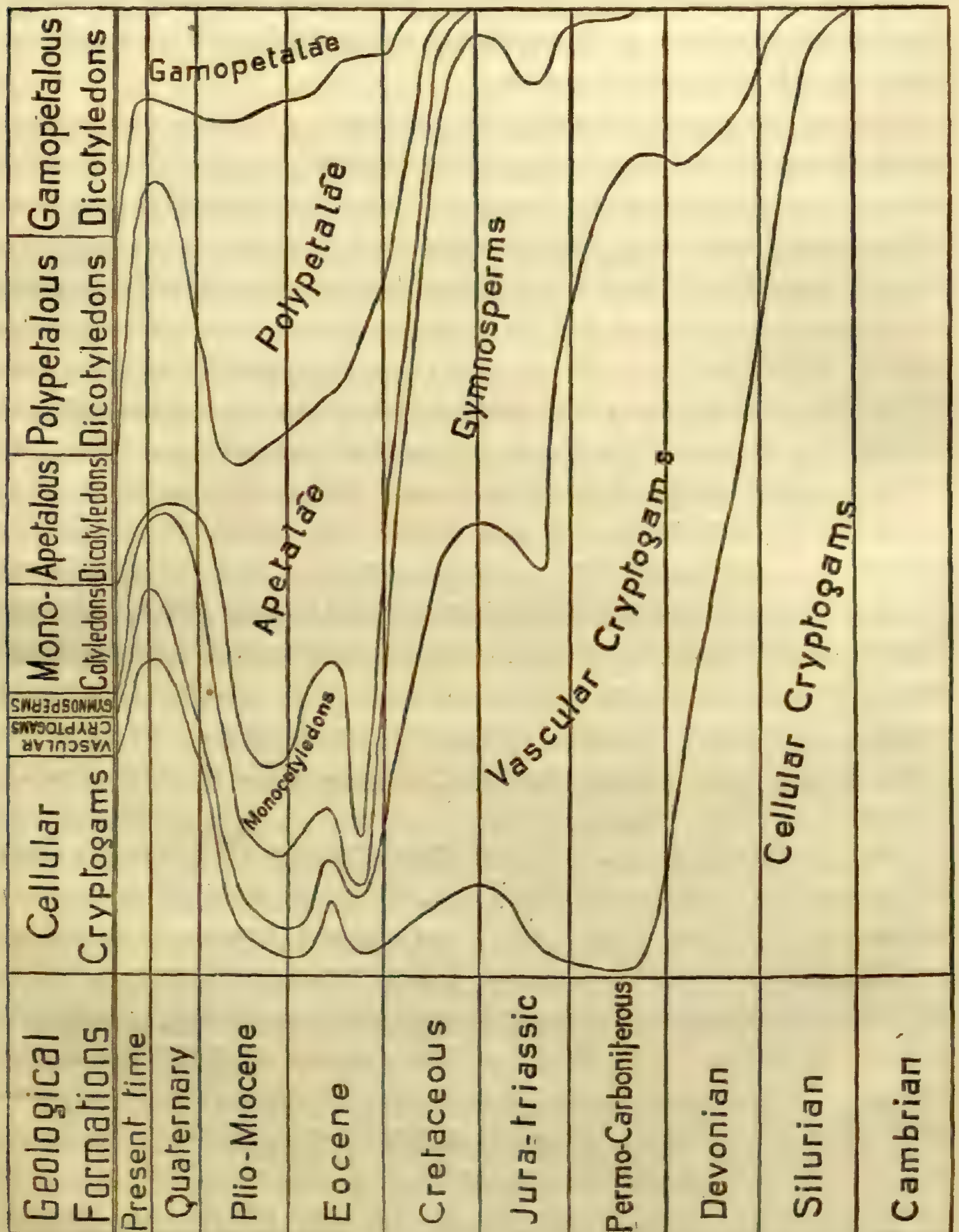
is one of the most striking facts revealed by palæontology. Heer's *Populus primæva*, from the Urgonian of Pattorfik, Greenland, described ten years ago, still remains the sole representative of this sub-class in any formation below the Cenomanian and the most ancient dicotyledon known.[1] Not less remarkable, however, has been the march of these plants since their earliest manifestation, as will presently be shown.

Having thus noted the time of first appearance of each principal type of vegetation, we may now hastily glance at the mode of subsequent development of each. This might be done from two distinct points of view, the absolute and the relative, but as the former would be powerfully affected by the defects in the geological record, no attempt will be here made to represent it graphically. The relative point of view, however, admits of such representation which in a certain respect eliminates these defects. Collectors of fossil plants do not seek specially for particular types. They take all they find, and hence if the chances of preservation are equal for all types the chances of finding plants of a particular type would depend upon its abundance in the flora of the epoch to be studied, while conversely, the degree to which any type of plants is represented in collections would be a fair measure of its abundance in the flora of the given epoch. The accompanying diagram is based upon this assumption, and clearly shows the progress of each of the leading types.

The facts sustain in a striking manner the early generalization of Brongniart, against which Dr. Lindley so strongly inveighed as late as 1836, that there has been a general upward tendency in structural development through the geological periods. The Silurian was the age of cellular cryptogams, consisting principally of marine Algæ. The reign of the vascular cryptogams began with the Devonian and closed with the Permian, the ferns constantly taking the lead but being strongly supported by the Calamariæ and Lepidophytes throughout the Carboniferous. The gymnosperms assumed supremacy in the Trias, the Cycada-

[1] Fossil wood supposed to possess the dicotyledonous structure has several times been found in lower formations (see J. G. Kurr's "Beiträge zur fossilen Flora der Jura-formation Württemberg," Stuttgart, 1845, page 9; Sorby "On the occurrence of non-gymnospermous exogenous wood in the Lias near Bristol," Microsc. Soc. Trans., III, 1852, pp. 91–92), but evidence of this class is not yet accepted as conclusive.

ceæ taking the lead in the Keuper and holding it through the Oölite, then surrendering it to the Coniferæ, which held it far up into the Lower Cretaceous. The monocotyledons never held a dominant position but increased steadily throughout the Meso-



zoic, reaching their highest expression in the palms and their greatest relative predominance in the Eocene, but probably attaining their highest absolute development in the Oligocene or Lower Miocene. The dicotyledons, which, as already shown, made their first observed appearance in the Urgonian, or Lower Cretaceous,

progressed with such amazing rapidity as to become the ruling type in the Cenomanian, or Middle Cretaceous, furnishing in that formation over seventy-two per cent of the total known flora of the globe, which is nearly as high a percentage as they attained at any subsequent period. Of the present flora they form less than sixty per cent, and doubtless their relative position in the fossil flora is exaggerated, owing to the failure of the myriad fungoid forms, existing then as now, to leave any traces in the rocks.

The systematic value of the prevailing subdivision of the dicotyledons into monochlamydeous and dichlamydeous, and the latter again into polypetalous and gamopetalous, diminishes with the progress of research. The first of these divisions is invalidated by the fact that the natural affinities are between apetalous and polypetalous and not between apetalous and gamopetalous plants, the last named division being the highest in point of structural development. The apetalous division forms forty-five per cent of the dicotyledons in the Cenomanian, thirty-seven per cent in the Miocene and only fourteen per cent in the living flora. The polypetalæ are fifty per cent in the Cenomanian, forty-eight per cent in the Miocene and forty per cent in the living flora. The Gamopetalæ are five per cent in the Cenomanian, fifteen per cent in the Miocene and forty-six per cent in the living flora. Making all due allowance for the fact that the Gamopetalæ of the living flora are more largely herbaceous than either of the other divisions, which fact, properly viewed, constitutes a strong proof of their greater recency, this evidence would seem quite sufficient to establish the order of development of the dicotyledons as here arranged.

As still further confirming the general law of development in vegetable life, we observe the great decline of the cryptogamic types that predominated throughout the Palæozoic. The same is true to a less extent of the gymnosperms, and notably of the Cycadaceæ. The monocotyledons have also probably declined, as have the lower or monochlamydeous dicotyledons. The only one of all the leading forms of life of which we can positively say that it still preserves an upward tendency is the gamopetalous division of the dicotyledons, which, unless arrested by human agency, seems destined to form the dominant type of vegetation or the next geologic epoch.

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 691, July number.)

III. Development of the Nervous Function.

In the last section the mechanism of the nervous system was considered. The modes and causes of its special development, and particularly the influences controlling the evolution of the cerebrum, now call for consideration. As already said, consciousness may, for all we know to the contrary, attend every nervous manifestation. But consciousness in that clearly defined and centralized condition which we call the psychical is the outcome of a long era of development through which the nervous mechanism has attained a high degree of specialization. At first excessively vague and faint it gradually grows stronger and more definite, until it reaches its ultimate in the vigorous, clearly defined and highly developed consciousness of man.

This result has been in great part an outgrowth of the growing sensitiveness of animal life to external energy. In the lowest forms this sensitiveness is undoubtedly very slight. In the Protozoa it is probable that touch is the only sense that has any degree of strength, though it seems evident that these animals are somewhat affected by influences emanating from substances at minute distances. Whether the vague sensations which attract the Protozoa to their food arise from physical emanations of the nature of smell, or from some heat or light influence, cannot well be determined. In many of the lower Metazoa there is no indication of any superior sensory powers. In sessile forms, indeed, the powers may be yet lower. The sponge, for instance, may possess only the sense of touch, resident mainly in its cilia. The fixed polyps may possess no higher sensitiveness, though in the free forms, such as the Medusæ, there is an evident display of more varied and delicate sensitiveness.

Yet in all the lower forms of animal life one thing is evident. External energy does not force its way into the body in any very great quantity, and it is quite possible that every sensation may call forth a motor response. This, indeed, seems to be the case in yet higher forms of life. The sensations are so limited in number that there can readily be a motor response to every sensation, and there is no reason why there should be a change from

the primitive system of direct and immediate communication between the organs of sensation and the organs of motion. If in these forms intermediate ganglia exist, their sole duty may be that of a division of the current of energy and the drafting it off to the proper muscles.

As we ascend to higher forms of animal life, however, a more developed sensitiveness appears. This is a necessary result of animal development. Higher life conditions require superior powers of perceiving prey or enemies, and greater quickness in pursuit or flight. For this, sensitiveness to more and more distant impressions, to more delicate conditions of energy, and to a greater variety of emanations becomes requisite. The originally general sensitiveness must become specialized, and the nerves attain varied endings suitable to the reception of diversified modes of vibration or contact.

This absolutely necessary consequence of the development of animal form yields another consequence of considerable importance. If the sensory organism becomes highly developed and capable of receiving delicate impressions both from near and far, the inflow of energy must become so great and continuous that a motor response to every sensation will become impossible. There must be some means of checking the inflowing current and preventing the whole of it from reaching the muscles, or the body will wear itself out from the very superiority of its organization. If the sensory currents be permitted to reach the muscle fibers these cannot but respond, and would thus be steadily in the condition of fatigue and incapability. It necessarily follows that a full development of nervous susceptibility is impossible unless in some method the excessively numerous external energies which beat upon the body can be prevented from bringing all their force to bear upon the muscles.

This is the secondary phase in the development of the nervous function, and nature has chosen two methods of attaining the requisite end. In the one case, as the nervous substance grows more susceptible its sensitive terminations are covered by an indurated material, through which energy cannot readily force its way. The special organs needed to receive the more delicate forms of energy are developed only on limited tracts of the body, and touch and temperature alone are capable of affecting the whole surface. With the great mass of animals the effects of

temperature are checked by some sort of protective covering, while largely in the Invertebrata, and to some extent in the Vertebrata, the effects of touch are diminished by a thick armor of scales, horn or shelly matter. In the sessile and inactive forms only a small portion of the body is usually exposed to sensory influences, the remainder being incased in solid armor through which no ordinary impression can penetrate.

As animals grow superior in organization, however, the need of swift and varied motion renders this hard covering a disadvantage, and it is thrown aside, exposing the whole body to the assaults of energy, while the organs of special sense grow constantly more and more delicate and varied in their susceptibility. In these cases, then, the body is invaded by an enormous multitude of sensory currents, which, could they all reach the muscles, would cause a serious loss of physical energy. To check this inflow the second method referred to comes into play. The nerve currents are forced to traverse ganglia and pass through the fine fibrillæ of the cells, which, like fine wires in the electric circuit, check the current, only permitting a portion of it to pass, while the remainder outflows into the ganglion as heat, or is converted into some more special mode of energy.

But this alone would not answer the purpose. In all high animal organisms it is necessary that the inflowing energy should be under special control. Some power of discrimination must exist, or must arise through the action of natural selection, to decide which currents of sensation shall pass onward to the muscles, and which shall be partly or completely checked. Only in this way could the nerve currents be prevented from calling up general and indefinite muscular responses, instead of the particular and well adapted responses necessary to yield the motions demanded by the best good of the economy. This is the third element in nerve evolution, and needs now to be considered.

It is well known that the nerve fiber is a very imperfect conducting material as compared with the metal of the electric circuit. How it conducts is an unsettled question. Its current resembles that of electricity in being simply a motor influence, perhaps in both cases set free by chemical change at the starting point of the circuit. Whether it resembles electricity in being a sort of radiant vibration through solid matter cannot be told. All we know is that its onward movement is excessively slow as

compared with electricity, and that the peculiar conditions of the instigating influence persist in the current. Yet though the nerve current moves slowly there is no indication that it meets any check in the conducting fiber or in the organ of sense reception. Probably every motor influence that can make its way through the outer surface to the nerve endings, of sufficient vigor to induce chemical action in or otherwise affect these endings, produces a nerve current without reference to its character. And every such current received by the nerves is transmitted and apparently even strengthened as it flows inward.

How is it, then, that some such currents pass directly onward to the muscles, while others are checked and disappear as current influences? There is strong indication that the ganglia perform this duty. The diminution of the diameter of the fiber in the nerve cell is a precise equivalent of the method adopted to produce the same effect upon the electric current. But the point here to consider is that of the evident discrimination displayed. In the sympathetic nerve system there is no evidence of such discrimination. There is a checking influence exerted, but it acts upon all currents alike. Each fiber probably passes through a chain of ganglia, each of which lowers the intensity of the current until it is finally unable to force its way further. Thus the distance to which a sympathetic current will flow depends upon its original strength. When, for instance, in the process of digestion the sympathetic nerve extremities are excited by the contact of food, certain muscles are affected, and produce the peristaltic movement of the intestine. If the contact influence is slight, this movement will be slight and local. If contact be vigorous the effect will grow more energetic and extend further, while a wider range of glands will be excited to action. If the contact influence be abnormally vigorous the effect will pass onward from the sympathetic to the spinal nerves, and the cerebrum be notified of the abnormal condition, while its motor lines of connection with the sympathetic nerves will be called into activity. We have every reason to believe that it is the ganglion not the fiber that thus diminishes the energy of the current. And the distance to which this current can travel depends on its vigor and the number of ganglia through which it is able to force its way.

The same is the case with the cerebro-spinal nerve system. Nerve impulses of a character that is usually checked may force

their way inward if exceptionally vigorous, and act upon the muscles. And significantly, in such cases, the motion produced is not special and definite but vague and general. The impulse, when it has forced a passage through the ganglia, does not select one motor channel in preference to others, but makes its way over the most conductive portion of the general motor system and calls many widely separated muscles into action. In this we have an indication of the original action of the nervous system, such as existed before specialization began and such as yet seems to exist in the sympathetic system.

The action of the ganglia, then, appears to be at once repressive and discriminative. Certain motor influences seem more capable of forcing a passage through the ganglionic resistance than others. The principle here involved seems to be that every motor influence of a new or unusual character is resisted, and ready passage is only allowed to motor influences to which the fibrillæ have become adapted. And here natural selection has come actively into play. Let us suppose the animals of a certain species to be subject to a definite series of motor impressions, each of which makes it way through the gangliar obstruction and tends to flow out generally to the muscular organs. Yet being insufficient in quantity to occupy every nerve, it will follow the largest, or those over which it finds the most open channel. Thus while the responsive movement might be somewhat general, certain muscles would obtain a surplus of the current and respond more vigorously than the others. In such a case natural selection must rapidly operate. The movements of some individuals would prove protective. Others would perish. And on the principle that the current of energy finds easiest way over the channel which it has already traversed, this particular motor influence would pursue its old channel in preference and be resisted by the other nerves. In like manner others of the sensory impressions might gain other favorite channels, and every sensation in time produce a particular action, adapted to the highest good of the animal.

But if the nerve fibers are only readily conductive to familiar motor influences, and if the gangliar cells resist all unusual sensory currents, another element comes into the situation. It is not only a question of the selection by the sensory currents of certain motor nerves in preference to others, but also of making

their way at all through the ganglia. A new sensory current may in some animals pass onward and produce motion. In others it may fail to reach the muscles. Natural selection would act here also, and might preserve the individuals which failed to respond to this sensation. Thus in a single animal some sensations will come to produce a certain motor response, other sensations another response, and still other sensations no response, and only the individual which is affected in just this manner can survive, since any other series of movements or non-movements would cease to be protective. Such an animal would be a correctly adapted reflex organism. No conscious or psychic powers would be necessary for its preservation.

The repression of the sensory current by the ganglia is probably a developmental characteristic of animal life. It only became necessary when sensation became active and abundant motor energy penetrated the body. It was absolutely necessary for the good of the economy that every sensation should not produce a motion, and the original nerve cells developed into ganglia, partly through this need of repression. These checked the great mass of the motor impulses, only permitting familiar ones to follow their ordinary channels. Yet such repression was not an intelligent one. It was largely governed, in fact, by the comparative vigor of the current. The principle seems to be that every sensory current, if sufficiently vigorous, may make its way through the gangliar resistance and affect the muscles. But currents of a special kind, which have already established a familiar channel, need less vigor to make their way through the ganglia, though even these are checked if very feeble. Finally special currents which have been repeated a great number of times may make their way onward even if very feeble. And in every case an abnormally strong current, even if it be of a kind that has established a familiar channel, will force itself to some extent upon other nerves and produce general and indefinite motions. This is the material out of which natural selection chooses its new adaptations. Finally a nervous organism thus specially adapted to surrounding conditions may be hereditarily transmitted, and a special series of reflex actions or resistances become inherent in the species.

The next question to be considered is, that of the disposition of this repressed current energy. So far, in accordance with the

electric analogy, we have considered it as transformed into heat. Such is what must become of it in a purely reflex organism, whose whole duty is to let certain currents pass and to repress others. But only in general cases does the repressed electric current become heat. In particular cases it becomes magnetism, mass motion and other forms of energy. Such seems to be also the case with the sensory current. As the checked electric current may be so employed as to produce a permanent condition or modification in certain matter, so is the checked sensory current. Memory results. That is to say that some substance contiguous to, or forming part of, the ganglion becomes permanently modified by the checked current of energy and assumes a condition which is persistent. And the change thus produced is not identical in character for every condition of energy, but varies with every variation in the producing cause. Thus the special character of the sensation is indicated in the particular effect it has exerted on the modified substance.

Such seems to be the character of memory. It is a condition produced by a motor influence. But motion can act only upon substance. And wherever it yields a localized, permanent, inherent effect this effect can only be an organizing one, exerted upon some substance. No motor effect can persist unchanged in any substance except it take part in the organization of that substance and produce in it some permanent modification. And it is quite within the limits of possibility that such a new condition may react on the current-bearing fibers and reproduce motor energy in the latter. Such seems to be the characteristic of memory. It is not necessarily conscious. Memory, as a rule, persists outside the range of consciousness. But it is necessarily a definite and permanent condition in something, and the word *something* necessarily signifies *some substance*.

Thus the current of motor energy which forces its way from external nature into the body, and is borne inward over the channel of the nerves, yields two opposite effects. When it reaches the muscles its effect is disorganizing. It causes chemical disintegration with an outflow of general energy, in which that of the nerves is merged and lost. When it is checked in the ganglion it seems to exert an organizing effect, perhaps attended by chemical integration, or the formation of chemical molecules of a high order. As to this, of course, nothing can be said, but that it

yields a specialized effect for every special mode of sensation, and that this effect is permanent, the phenomena of memory prove. And no such effect can be produced by motion upon substance except it take part in the organization of that substance. Motion otherwise related to substance must flow out and disappear. Only the motion to which formation is due persists in any molecule or organized mass.

Possibly every ganglion has its memory. But it is much more probable that in the continued development of the nervous system, as superior or more centralized ganglia originated, the function of the lower ganglia became simply distributive, and they ceased to exert a repressive influence upon the current. Thus in a vertebrated animal, for instance, it is not improbable that the discriminative power of a spinal ganglion lies between its sending a sensory current directly to some muscle or sending it upward towards the cerebrum. It is a question of short circuiting the current, or of transmitting it to the central office. To the extent that reflex action has been established in the Vertebrata this short circuiting is the method pursued. It is the normal method in the sympathetic nerves, whose current makes its way to more and more central ganglia only as it grows in strength or becomes unusual in character. It is the method in many of the cerebro-spinal nerves for actions that have become habitual, like those of walking, for instance. Only when the regularity of step is in some way interfered with does the sensory current force its way to the cerebrum and arouse consciousness.

In nerve development, then, an early stage is the appearance of the ganglion with its discriminative and repressive powers and its memory record. A later stage is the appearance of several ganglia, one more central to the whole nervous system than the others. In this case, as we may conceive, the function of the inferior ganglia becomes confined to discrimination between sending a sensory current directly to the muscles or onward to the central ganglion. The power of final decision and repression of the current may be confined to the latter, and it may become the sole seat of memory. This centralization makes continuous progress through the lower life forms. It is clearly indicated in the insects, yet here it is doubtful if it has gained ascendency over reflex action, to which the great mass of insect motions seem due.

For this reason the loss of the head section in certain insects seems very slightly to decrease their motor powers.

As we ascend through the Vertebrata, however, nervous centralization rapidly proceeds. The cephalic ganglion, or mass of cephalic ganglia, grows more and more predominant over the inferior ganglia, and the sensory currents are diverted more and more fully towards this central region. Throughout the whole upward range the phenomena of nerve development indicates that reflex action grows less and less, and conscious action more and more declared. In certain fossil vertebrates of huge form, the mass of the inferior surpasses that of the cephalic ganglia, indicating a great degree of reflex action. Throughout the fossil series cephalization seems to steadily increase, indicating a growing superiority of conscious over reflex action.

Yet this change was only made by slow stages, and an interesting intermediate stage seems to have intervened between reflex and habitually intelligent action. This is the stage of instinct, in which reflex action and consciousness seem to be combined. In this stage the sensory currents, on reaching the inferior ganglia, seem to partly follow an habitual channel to the muscles, partly to pursue a channel to the central ganglion, where they awaken consciousness. It is a usual stage in the change from fully conscious to reflex action. In every such case intelligence may exercise some controlling function, with a possible modification of the reflex action. Finally, in the highest animals, the upward channel has become the habitual one for all but the most deep-seated or incessantly continued sensory impressions, and intelligent has grown more and more dominant over reflex and instinctive action, until in man it has become the controlling agent in the great sum of actions.

There is a principle, already stated, to which this increasing cephalization seems due. The nervous system is not readily conductive to unusual sensory impressions. It has become so to ordinary impressions, each of which has established for itself a habitual channel. But every unusual impression is checked at the ganglion, and can only make its way onward if of considerable strength, and then over the general motor system, not over any particular motor nerves. If this sensation becomes an ordinary one, natural selection decides whether it shall gain some settled channel of outflow to the muscles, or shall be finally

checked at the ganglion. And another result of great importance is that every such unusual impression, thus partly or wholly checked in its course, produces the effect of memory at the ganglion. Thus a record is laid up in the memory of every unusual impression, which is vivid at first but grows less and less so with every repetition of this impression. Finally, when a particular sensation grows habitual it may cease to affect the memory record. It has already made a deep impression there, and it subsequently is received with less and less consciousness of its existence. If it passes on to the muscles it may do so utterly without affecting consciousness, or become completely reflex.

As centralization proceeds it seems probable that all such unusual impressions are directly transmitted from the inferior to the central ganglia. In this direction there appears to be the freest channel of conduction for sensory currents. Usual impressions may have opened direct lines to the muscles, but unusual ones pursue a more open and general channel leading towards the central organ, in which the final duty of discrimination is exercised. And as a consequence, in the higher vertebrates the main center of reflex action seems to have become the ganglia at the base of the brain. In the insects the ganglia of each section seem to exert an active reflex function. This has largely ceased to be the case with the spinal ganglia of man, whose main reflex center is the cerebellum and the contiguous ganglia.

In all the higher Vertebrata a nervous organ has been developed which does not seem to exist in the invertebrate animal world. This is the cerebrum. It is a special gangliar organ devoted solely to the duty of memorizing, and one in which consciousness has become centralized. In the ant, the most intelligent of invertebrate animals, there is no apparent differentiation in the head ganglion. It is a single organ, centering in itself duties of reflex and instinctive action, and of memorizing. In the highest animals these duties have become separated. The inferior brain ganglia apparently possess the function solely of reflex action, if we may view as a constituent part of this function the diversion of unusual impressions upward to the cerebrum. That is to say, they have lost all power of checking the flow of nerve energy. Memorizing and psychical action seem confined to the cerebrum. And intermediately sensations of increasing frequency grow partly reflex and partly affect the cerebrum without calling

out any conflicting orders from the intelligence. Such cases are those named instinctive. Their steady course is towards the fully reflex condition. The memory record of them may become so complete, through frequent repetition, that finally they fail to produce any effect, or to arouse consciousness. Cases of this kind are by no means confined to the lower animals, but may be found in some of the most difficult operations of the human sensory organism. In the oft-quoted case of the skillful pianist, for instance, as the fingers become habituated to a certain series of movements, attention may be more and more withdrawn from the action until it reaches the instinctive stage, a vague consciousness of the movement perhaps persisting but no intelligent oversight being necessary. Only when some change in the succession of sound is produced, however caused, does consciousness at once become again active. The element of the unusual has been introduced and the sensory current immediately makes its way in its full force to the cerebrum, arousing the powers of the dormant attention.

The cerebral organ of man does not seem to be a constituent part of the general nervous system. Its sole duties are connected with the evolution of the mind. If it be completely removed animal life does not necessarily cease. But its removal shows to what an extent the life action is reflex. The lower vertebrates may continue to live for a long time without the cerebrum, and perform most of the essential duties of life. Yet every trace of memory goes with its removal, and they act only as automata. In insects the life functions are still more fully performed, showing here an inferior dominance of the mental powers. Possibly but for the shock to the organic system by its removal, its function of memorizing might be in part relegated to the cerebellum, and the embryo state of a new mental development be produced.

According to the hypothesis of Professor Christiani,[1] devised from experiments with disbrained rabbits, the cerebrum forms a kind of secondary circuit, into which a large portion of the energies enter and are stored up, while the basal ganglia form a primary circuit, which transforms the energies into reflex motions. He found that with the removal of the cerebrum all energy was transferred into reflex motion, so that disbrained and decapitated

[1] Journal of Physiological Society, June 20, 1884.

animals displayed much stronger reflex action than normal ones. In normal animals much of this distributed energy ascends to the cerebrum, where it becomes converted into consciousness and ideas.

According to Luys the optic thalami are intermediary sensory organs interposed between the purely reflex phenomena of the spinal chord and the activities of psychical life. So the corpora striata are seated at the summit of the motor nerve system. Thus it becomes a question of gangliar discrimination whether a sensory impression, on reaching the optic thalamus, shall be at once transferred to the corpus striatum and thence through the motor nerves to the muscles, or shall proceed to the cerebrum and motor impulses descend to the corpus striatum through that channel. In this latter case we venture to hypothesize that all reflex action vanishes, and that all sensory impressions that ascend to the cerebrum end there. If subsequent action take place it must be in response to new initial energy emanating from the mind and wholly governed by the intelligence.

These considerations lead to the idea that the cerebral organ may be in an anatomical sense a secondary circuit. That is, that the nerve fibers of the body may not be in direct communication with the cerebrum. It may be possible that the sensory fibers that enter the basal ganglia are continuous through the nerve cells only with the outgoing motor fibers, and that the cerebral fibers which enter these ganglia form a circuit of their own through fibrillæ of the same cells. In such a case the influence of the primary on the secondary nerve circuit could be inductive only, and we would have a mechanism similar to that of an electric inductive system. This idea of course can have no warrant in experiment, but it is offered as a suggestion that the many close analogies between the nervous and the electric current may be completed by a condition like that of induction, which plays so prominent and important a part in electric phenomena. The sheathing of the nerve fibers by the medulla seems to be an insulating apparatus. Their naked condition in the ganglia must favor induction, and renders it possible both that the transfer of a sensory current to two or more outgoing nerves may be through induction between the fibrillæ, and that its transfer to a cerebral nerve may be through induction. It is not impossible, indeed, that the check to the sensory current in a ganglion may arise

through inductive transfer of its energy to a series of fibrillæ which are short circuited in the ganglion and make no connection either with ingoing or outgoing nerves.

This hypothesis of an analogy between the action of the nervous current and that of electric induction is at least of some interest, and may be further pursued. We have argued that to this checked current the phenomena of memory are due. If it arise from the transfer by induction of the sensory current to a series of fibrillæ, forming a secondary short circuit through the ganglion (continuous, of course, as all inductive currents must be), then we would have here a new apparatus for the operation of organic forces, and one leading directly to the development of a separate cerebral organ. For, as above considered, in the development of the nervous system the check to the sensory current in the ganglia became a duty of growing importance, and the volume of checked energy steadily increased with the growth of nervous susceptibility. If, then, this check took place through the action of a separate inductive circuit, this apparatus must have developed with its increase of duty. At first confined to the same cells which transmitted the reflex current, the inductive fibrillæ may have grown in length and number, and in time gained cells of their own, with connecting fibers. Through these cells the checked current would produce its final effect, whether of memory conditions or otherwise. By a continuance of such a process the cells of the inductive circuit might become separated entirely from those of the primary circuit, forming first a cerebral layer upon the central reflex ganglion, and finally a completely separate ganglion connected only by nerve fibers with the system of reflex ganglia.

Such is conceivably the mode of origin of the cerebrum, and the character of its nerve relations with the nerves of the reflex system. As intelligence grew and the great mass of sensations were transmitted to the cerebral circuit, this organ would necessarily greatly develop, until from a series of secondary fibrillæ short circuited through one or a few cells, it became the great cerebral organ of man, with its highly important function of the evolution of the mind.

We may very briefly recapitulate the conclusions to which the foregoing arguments have led. The motor energy of the external world makes its way in various forms or phases into the ani-

mal body by the channel of the sense organs and the sensory nerves. Reaching a ganglion it is received by the cells, perhaps by many of them through the division of the fiber into its constituent fibrillæ. It either continues over its original fibrillæ to the motor nerves which issue from these cells, or is transferred, partly or wholly, to other fibrillæ by induction. In such a case it may be carried to other motor nerves, or enter upon a short local circuit and yield the local effect called memory; that is, a peculiar organizing effect in which is represented its peculiar character. Or this secondary circuit may convey it to a higher or more central ganglion, in which the same modes of distribution may be exercised. In highly developed animals it may pass through several such intermediate ganglia, and be finally, in part or wholly, transferred by induction to the cerebral ganglion. In this it exerts but one action, that whose effects we call memory, a permanent transformation produced in some organizable substance. This effect is the germ of all mental development.

(To be continued.)

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AFFINITIES OF ANNELIDS TO VERTEBRATES.

BY E. A. ANDREWS.

AS a group the annelids exhibit in a prominent degree both bilateral symmetry and segmentation. The former is well expressed in the adult, in the early larval stages and even at the period of closure of the blastopore, when the radial symmetry of the gastrula becomes replaced by bilateral symmetry.

Segmentation, so pronounced in the adult, is not found in what we may regard as the most primitive larval form, the Trochophora of such forms as Serpula, or as more perfectly expressed in some species of Polygordius.

These two fundamental characters, bilateral symmetry and segmentation, naturally lead to a comparison of this group with the other segmented Bilateralia, of which the Vertebrata especially have attracted attention in seeking for the allies of the annelids; or rather in the attempt to derive the vertebrates from invertebrate groups, the annelids have furnished important aid.

Of those who have paid especial attention to the subject and who maintain a close relationship between the annelids and vertebrates, may be mentioned Semper, Dohrn and Hatschek. Semper seems to have advanced the most evidence in support of his

views, working mainly from the standpoint of comparative anatomy, and drawing little or no material from the larval stages of annelids. His views may be briefly (and thus necessarily imperfectly) stated as follows: Regarding the distinction of ventral and dorsal surfaces as of little morphological importance, we may make a direct comparison of annelid and vertebrate by supposing the mouth of the annelid to be a new formation, and that a mouth once existed upon the hæmal (dorsal) side of the annelid which was homologous with the mouth of the vertebrate (Figs. 1, 2).

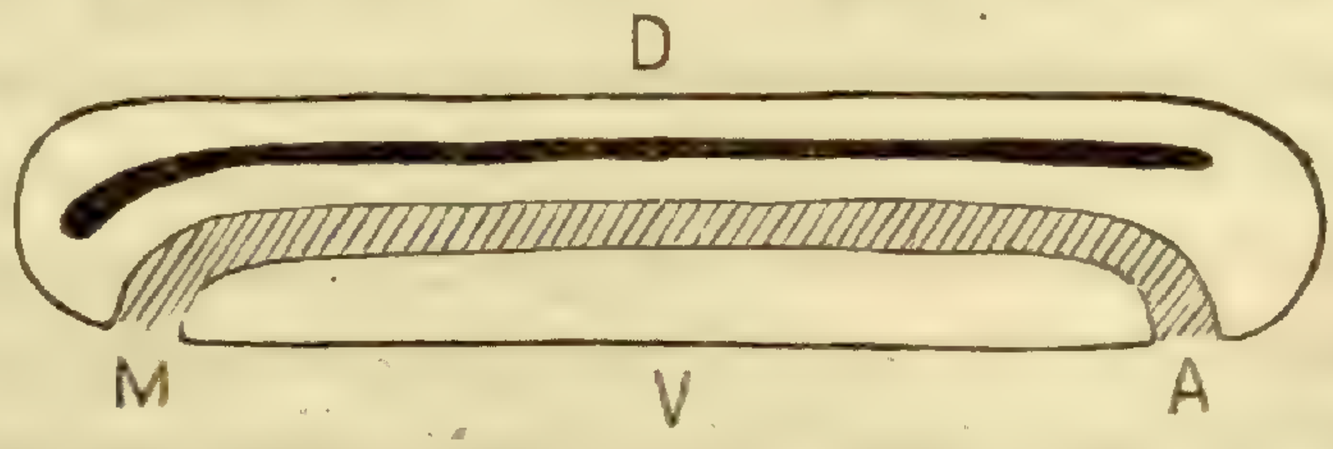


FIG. 1.—Diagram of a vertebrate according to Semper's view, showing relative positions of nerve-cord, digestive tract, mouth (*M*) and anus (*A*); *D*, dorsal, *V*, ventral surface.

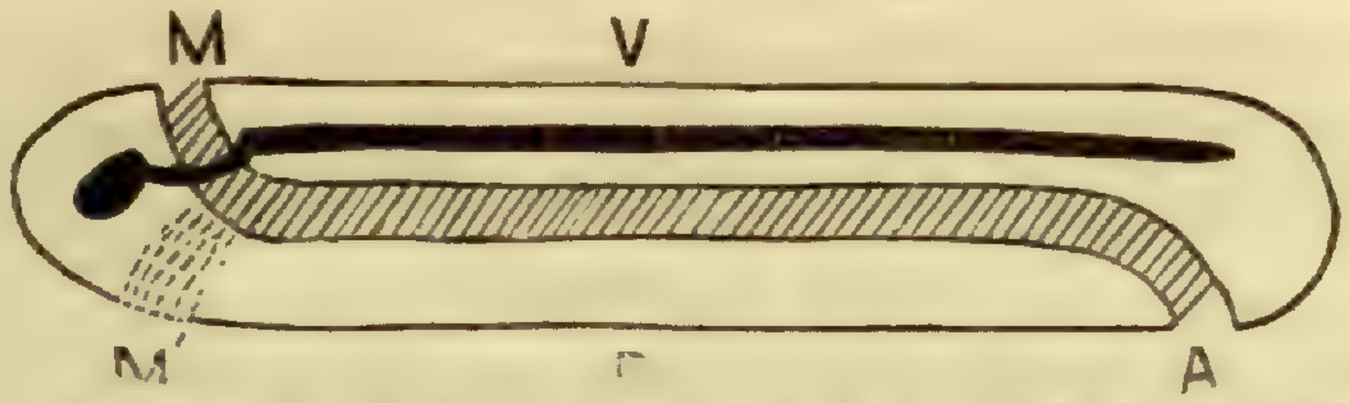


FIG. 2.—Diagram of an annelid according to Semper. *M*, mouth; *A*, anus; *M'*, primitive mouth; *D*, dorsal, *V*, ventral surface.

He draws close comparison between the muscles, nervous structures and excretory organs of the two groups, basing his views largely upon the study of the urogenital organs in the lower vertebrates and the process of asexual reproduction in certain oligochætous annelids.

In these forms new individuals are formed in chains by the appearance of budding zones across the body of the asexual parent, each of which zones gives rise anteriorly to the trunk of one zoöid, and posteriorly to the head of the next following zoöid, so that two adjacent zones form a new individual between them, and parts of the new individual in front of the anterior zone and behind the posterior zone. As these individuals eventually break loose as forms like the parent it is necessary that each acquire a new mouth and œsophagus, supra-œsophageal ganglion and muscles. In the formation of these structures from the preëxisting tissue and from more indifferent embryonic cells,

Semper finds an identity in fundamental plan between annelid and vertebrate. Though establishing so many homologies between the two groups, he does not derive one from the other, but inclines to the view that both are descendants of a segmented planarian-like ancestral form which on the one hand gave rise to the vertebrate group by the enlargement of its anterior ganglion to form a brain and by the union of its separate nerve cords along the dorsal side to form the spinal cord, while on the other hand the annelid was formed by the acquirement of a new mouth piercing the nerve cord or passing between the still separate nerve cords and by the closure of the primitive mouth.

Dohrn's views on the affinities of the annelids to the vertebrates are very interesting, if perhaps of less importance as being purely hypothetical.

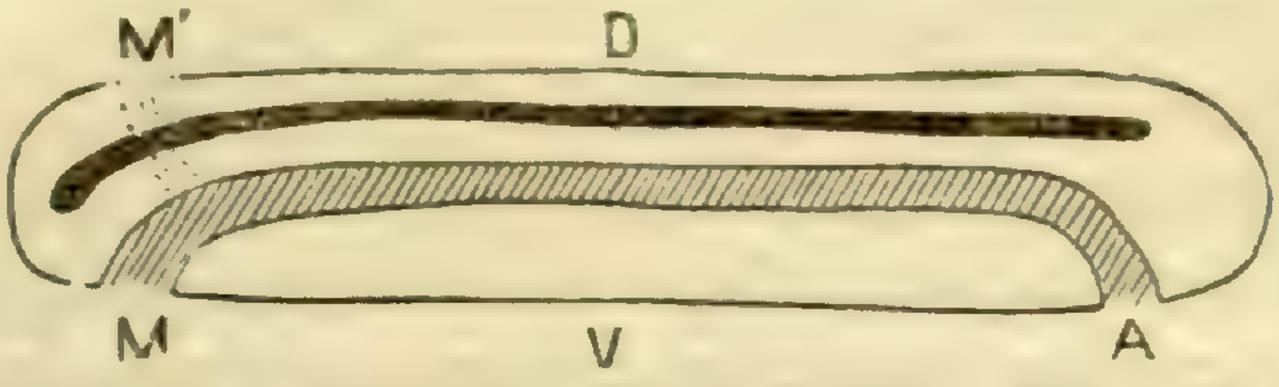


FIG. 3.—Diagram of vertebrate according to Dohrn. *M*, mouth; *A*, anus; *M'*, primitive mouth; *D*, dorsal, *V*, ventral surface.

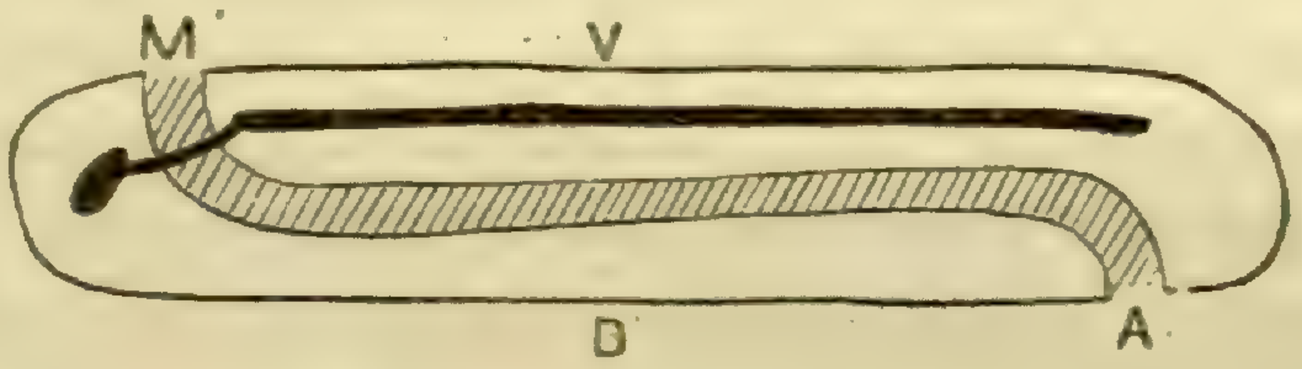


FIG. 4.—Diagram of an annelid according to Dohrn. *M*, mouth; *A*, anus; *D*, dorsal, *V*, ventral surface.

Homologizing the dorsal surface of one group with the ventral of the other, he finds the necessity of supposing a new mouth to have existed in one group, and unlike Semper regards the vertebrate as the form in which this new structure was formed (Figs. 3, 4). Seeking a trace of the primitive mouth of the vertebrate homologous with the mouth of the annelid, which is on the neural side, he finally concluded that the *fossa rhomboidalis* of the vertebrate represented the area of the nervous system formerly pierced by the œsophagus on its way to a neural mouth, there being thus a circum-œsophageal ring formed homologous with that of the annelid. The present mouth of the vertebrate was thus a new formation having no homologue among the annelids.

The genetic relationship of the two groups he conceives to have been that of diverging branches from a common ancestor. This hypothetical ancestral form was a segmented annelid-like creature with a chorda, gills on all the segments, supported by a cartilaginous rod on the side of each segment, with a neural mouth like that of an annelid and with a pair of segmental organs in each segment opening to the exterior and also internally into the digestive tract. From this ancestor the vertebrates arise by an interesting series of modifications in structure due to "change of function" of the primitive structures; some of the segmental organs gave rise to the mouth and branchial clefts, while others formed the genital and urinary ducts and even the anus; the branchiæ were variously modified to form the branchiæ of the vertebrate, its fins and limbs and perhaps the external genital organs; the cartilaginous supporting rods gave rise to the ribs, skeleton of the limbs and part of the skull.

This hypothetical ancestor was more highly specialized than the present annelids, which have since degenerated, perhaps (he thinks), owing to the sharp competition between the more annelid-like and the more vertebrate-like forms of the common ancestral group. The whole tenor of Dohrn's work inclines to the conclusion that annelids, like ascidians, etc., are degenerate vertebrates.

However satisfactory in explaining an origin of the vertebrates from an hypothetical ancestor this hypothesis may or may not be, it apparently is unsatisfactory in so far as it concerns the annelids.

Much of the evidence in support of Hatschek's views is derived from a consideration of the development of annelids, both of Polychætæ and of Oligochætæ.

His comparison of the two groups, annelids and vertebrates, is essentially that of Dohrn's (Figs. 3, 4) except that he does not place the point where the primitive œsophagus pierced the nervous system at the *fossa rhomboidalis* but at the *hypophysis cerebri*, a position more comparable to the present position of the mouth among the annelids, as it is farther forward, in the unsegmented portion of the head. He reduces the excretory organs in both groups to a common type represented by a transient stage in the larva of certain annelids when the branched excretory tube in the head of a Trochophora larva sends back a branch into the trunk, this longitudinal tube gives rise to the segmental tube in each

segment of the trunk, and thus a stage is present where the segmental organs are connected by a common longitudinal duct. In the annelid this connection is lost (though perhaps retained in a few), while each segmental organ acquires an external opening. In the vertebrate the primitive connection persists, and no external opening is developed for each segmental organ.

The conclusion reached by Hatschek is that annelids and vertebrates have had a common segmented ancestor, which did not differ much from such a simple annelid as Polygordius.

The three authorities now mentioned represent sufficiently the views of those finding more or less close relationship between the vertebrates and the annelids; there are others who regard this relationship as very remote, if existing at all, either placing other invertebrate forms nearer the vertebrates or separating this group from the annelids, from consideration simply of the fundamental differences of the two groups. Among the latter may be reckoned Mr. Adam Sedgwick, whose ingenious hypothesis includes the question of the relationship of these two groups, though advanced with the much wider object of accounting for segmentation and the origin of the Triploblastica from cœlenterate-like forms. Founded upon the behavior of the blastopore and upon the structure of the cœlenterates, the hypothesis calls for a cœlenterate-like ancestor with mouth and anus part of one common opening to the digestive tract which bore diverticula on each side, indicating a segmentation, and communicating with each other as well as with the exterior; the nervous system formed a broad ring around the mouth-anus (Fig. 5). From this common hypothetical ancestor the annelids were derived by the separation of the mouth and anus, by the partial fusion of the two sides of the nerve-ring along the median line between the mouth and the anus, with atrophy of the part behind the latter opening

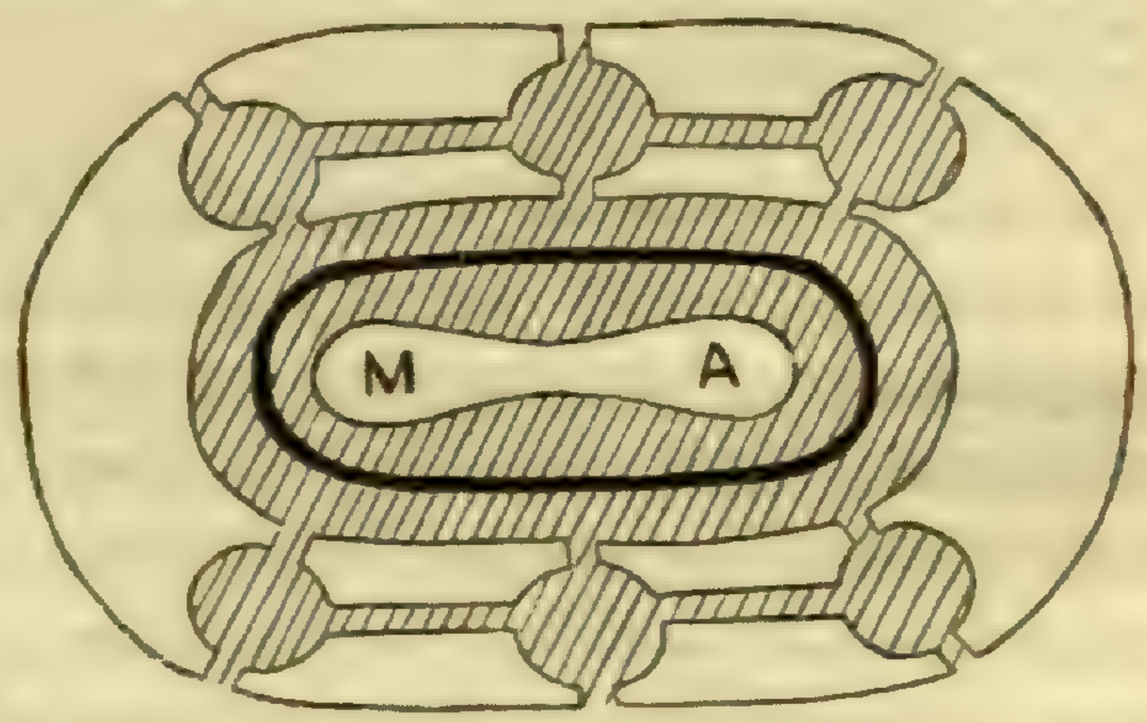
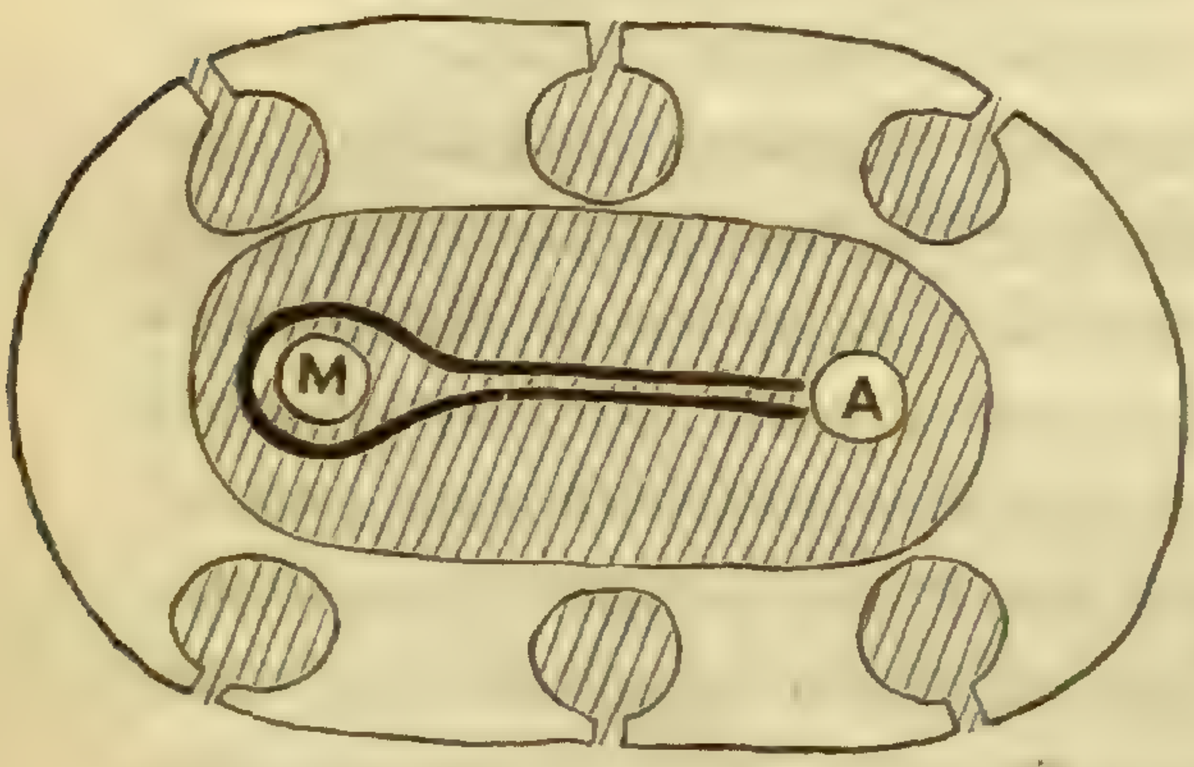


FIG. 5.— Diagram of Sedgwick's hypothetical ancestral form of vertebrates and annelids, showing mouth (*M*) and anus (*A*) as part of one common opening; digestive tract and pouches and nerve-ring.

and by loss of the connections of the lateral pouches with one another and with the digestive tract, thus forming the segmented body-cavity and the segmental organs. The vertebrate was formed by a more complete union of the lateral parts of the nerve-ring between the separated mouth and anus, together with disappearance of its two ends, by the persistence of some anterior pouches to form branchial clefts, by the loss of external openings for others which remained connected with one another and with the digestive tract at one point to form part of the body-cavity and the urogenital ducts, and finally by the retention of only the outer openings of the last pair of pouches which form part of the body-cavity and the abdominal pores. Mouth and anus are thus homologous in the two groups, and primitively neural in position; the mouth in the vertebrate acquired its present ventral or hæmal position by advancing around the anterior end of the body.



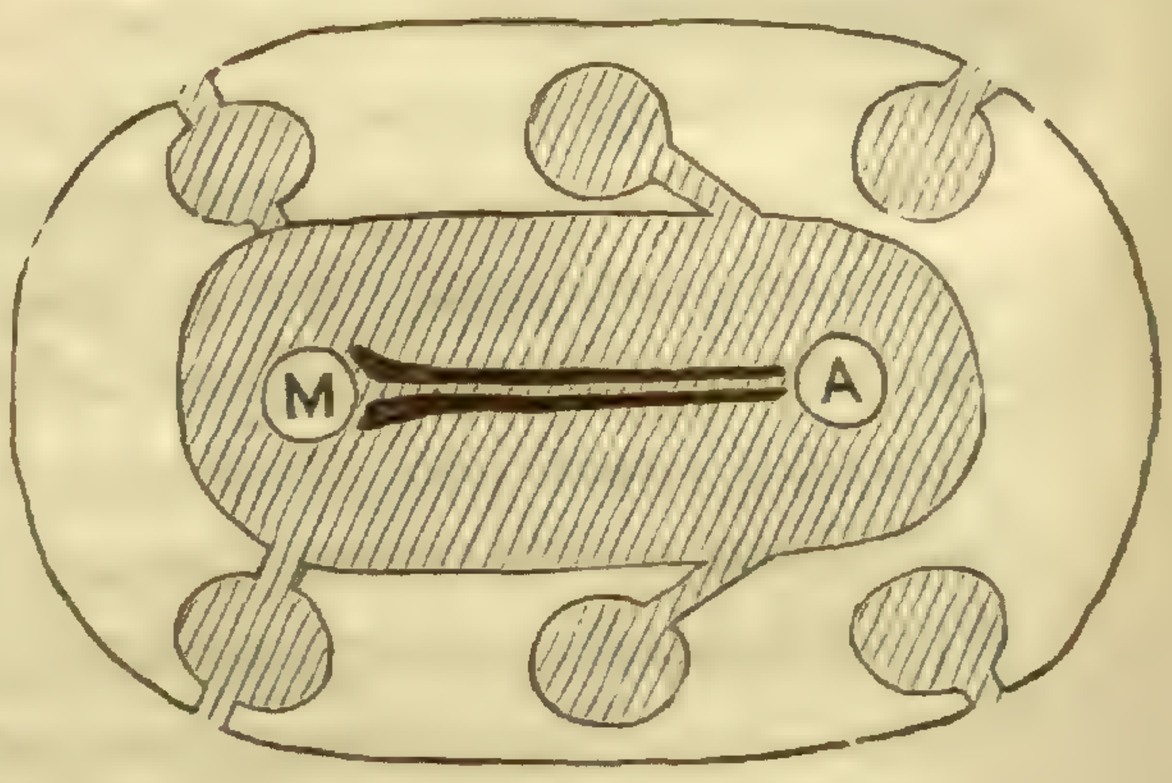


Fig. 6. Fig. 7.

FIG. 6.—Diagram of an annelid according to Sedgwick. *M*, mouth; *A*, anus.
FIG. 7.—Diagram of a vertebrate according to Sedgwick. *M*, mouth; *A*, anus, with spinal cord between.

A still more remote separation of the annelids from the vertebrates is required by the comparisons instituted by Goette from a study chiefly of the development of planarians and annelids; the fundamental ground-plan of the two groups is, he thinks, essentially different, as shown by the entirely diverse ways in which the gastrula is modified in the two to form the adult. In the annelid the blastopore closes along a line which corresponds to the longitudinal axis of the adult, the mouth being formed from its anterior part and the anus near its posterior end; the nervous cord is formed along this line of union of the lips of the blastopore. Thus the ventral surface of the adult represents the

blastopore area of the gastrula—the area opposite the upper end (summit) of the gastrula and in a plane at right angles to the chief axis of the gastrula, and along this ventral surface or blastopore area the nerve-cord is developed. In the vertebrate, on the contrary, the blastopore closes in a small area representing the posterior end of the adult and entirely behind the nervous system, corresponding in part to the anus in position. The blastopore area being thus the hind end of the adult, the ventral surface of the adult is formed from one side of the gastrula while the nerve-cord develops upon the opposite *side* of the gastrula in a position more nearly parallel with the chief axis of the gastrula.

In an annelid, then, the ventral surface with the nerve-cord correspond to the original lower or blastopore surface of the gastrula, and the mouth represents the anterior end of the blastopore. In a vertebrate the ventral surface corresponds to a side of the gastrula, while the surface homologous to the annelid's ventral surface is found represented in the vertebrate merely by the anal region, this being the blastopore area of the gastrula; the mouth in the vertebrate is a new structure formed remote from the area of the blastopore, and not at all comparable to the annelid mouth except in function.

Figs. 8 and 9, copied from Goette's work, will serve to illustrate this comparison of the two groups.

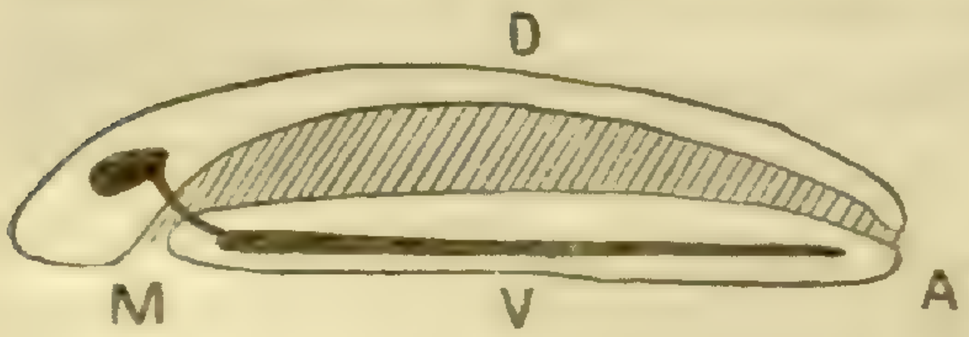


Fig. 8.

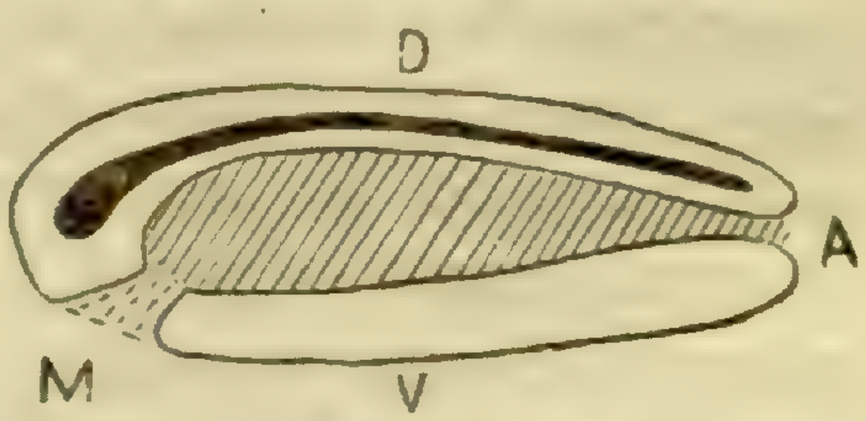


Fig. 9.

FIG. 8.—Diagram of annelid according to Goette. *D*, dorsal, *V*, ventral surface; *M*, mouth; *A*, anus. FIG. 9.—Diagram of vertebrate according to Goette. *D*, dorsal, *V*, ventral surface; *M*, mouth; *A*, anus.

The preceding statements may serve to indicate the chief views upon the subject, showing how much difference prevails in the hypotheses advanced to solve the important morphological problem of the exact affinities of the annelids and vertebrates, and at the same time indicating, perhaps, a tendency among those who have recently investigated the embryology of the annelids to

separate this group much farther from the vertebrates than was customary when most of the evidence was derived from the comparative anatomy of the adults.

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THE USE OF COPPER BY THE DELAWARE INDIANS.

BY CHARLES C. ABBOTT, M.D.

IN the *American Antiquarian* of November, 1884, Mr. Edwin A. Barber, speaking of the Indians of Pennsylvania, remarks:

"The copper age is represented by a few specimens of copper implements which have been discovered in different localities; but these could scarcely have been produced by the Lenni Lenape tribe. They were doubtless obtained from the ancient miners of Lake Superior, or at least were the remains of the industry of the mound-building race, which had found their way into Pennsylvania."

Referring in 1881 to the use of copper, by the New Jersey tribes, I also expressed the opinion that it was "not improbable that all the copper articles found along the Atlantic coast, were brought from western localities."[1] A careful re-survey of many localities where ordinary Indian stone implements occur in abundance; and correspondence with collectors in various portions of New Jersey and Eastern Pennsylvania now convince me that the use of copper, as implements and ornaments, was much more common than I supposed, and that among our Delaware Indians were many coppersmiths.

In the fifteenth annual report of the Peabody Museum of American Archæology, Professor Putnam describes two examples of copper spears, of which he says, while "these spear-heads closely resemble one in the State Historical Society of Wisconsin," yet they differ in the important feature of having smooth edges, while the Wisconsin specimen has a serrated point. These were both made "from a mass of native copper, hammered into shape, as shown by several small laminations which can be distinctly traced."

From the same locality a third example has been found (Fig. 1)

[1] Primitive Industry, p. 413. Salem, Mass., 1881. Geo. A. Bates.

which does not differ in any important feature from the preceding except that it has a smoother surface, and appears to have been ground or polished, after being brought to its present shape, by hammering.

FIG. 1.—Copper spear from Trenton, New Jersey.

Associated with the three spears was a small celt differing in no respect from scores of such objects found in Pennsylvania and New Jersey. The illustration (Fig. 2) represents the specimen, of actual size, and needs no detailed description of the object. Suffice it to say that the evidence of its having been hammered into shape is as patent as in the examples of spear-heads described by Professor Putnam.

Recently I have had the opportunity of examining a large collection of Indian antiquities, made in the neighborhood of Reading, Penn., and about Bristol in the same State. In this collection are several copper objects, all of which are of patterns that have already been found and described from other Atlantic seaboard localities. They are of much interest, however, as showing that more of such objects were in use than has been supposed, and proportionately as the number found here increases, does the probability of their having been brought from a distance decrease; for there is found both in Eastern Pennsylvania and in New Jersey, a very considerable amount of native copper. Indeed one mass weighing over one hundred pounds has been found in Somerset county, New Jersey.

Besides celts and spears there have been found many ornaments of copper, which clearly showed that they were made by the same hammering process; and the character of the metal showed, in many cases, that it was identical with the nodules of

impure native copper found in this region, and not, therefore, metal derived from the Lake Superior region.

When the Delaware and Raritan canal was dug, in 1832, there were found many skeletons of Indians during the course of the excavations. About the wrist bones of many were narrow bands of hammered copper, and some large crescent-shaped ornaments were also found. In one instance a grave was opened which contained a nodule of native copper weighing thirteen ounces.

This information was derived from a gentleman who saw many of the objects mentioned, and who carefully examined the skeletons and grave contents as they were brought to light.

Although the specimens have long since been lost, their identification as copper objects of Indian manufacture was carefully

FIG. 2.—Copper celt from Trenton, New Jersey.

made; and as this is information not readily obtained and has a distinct bearing upon the question of the use of copper among our Indians, it is worthy of being put upon record.

In the many small collections of Indian relics made in different localities that I have examined, I find that one or more celts, spears, arrow-points, bracelets, rude beads or fragments of sheet copper are sure to be found, and a tabulation of these objects, and the information derived from correspondence, gives the following results:

Celts, 11; spears, 5; arrow-points, 8; bracelets, 13; beads, 70; fragments of metal, 21; in all, 128 objects. When we consider how small a chance there is of such objects being found, and what a small proportion of such as are recovered come to the knowledge of archæologists, it is a most reasonable presump-

tion that the Indians had a more familiar knowledge of copper than merely as a material, ready-wrought, which they could only procure through barter with far distant tribes.

There is yet another feature which should be briefly dwelt upon. Among the fragments, so-called, of hammered copper, are several which have every appearance of being unfinished objects. One is, I think, intended for a finger ring, such as those from Ohio, described by Professor Putnam; and another strongly suggests those curious large ear-rings of which that author found so many specimens in recent mound explorations.

It would appear, then, from an examination of the copper objects found in Pennsylvania and New Jersey, that the weight of probability is strongly in favor of their home manufacture; and the similarity of the forms to those taken from areas where mounds occur is another fact in favor of the rapidly growing impression that the builders of these earth-works and the Indians of the coast were essentially one people.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— Just and courageous criticism is necessary to the maintenance of excellence in all departments of human activity. An indisposition to submit to it on the one hand and a fear to exercise it on the other, are sure indications of the weakness or decay of an important element of character. Even unfair criticism, bad though it be, is better than none, as it gives indication of life, and is sure to be itself corrected in the end. The attempt to suppress criticism is an unwise proceeding, which will react on its authors. It is better to "make a clean breast," if need be; and if facts do not require it, this also can be made plain. The force of just criticism is not weakened by suppression, but is rather increased in energy; while the expression of it draws the fire and silences the gun of the critic. It is a great error to confound criticism on behalf of the truth with personal hostility, yet it is an error by no means rare. To occupy a perfectly judicial attitude towards our own productions requires some moral elevation, which all men do not attain to. Unjust criticism, indeed, is ground for complaint against the critic.

Hence if the critic deserve the name, justice only will be his infallible guide.

People of sensibility and refinement shrink from controversy; and the enervated and dishonest endeavor to avoid it altogether. But it cannot be escaped without a total withdrawal from the field of action, or an attainment of perfection such as rarely falls to human lot. In the scientific world all the aspects of this question come before us from time to time. We meet the sometimes brutal vigor of German truth-telling, contrasted with the dexterous fencing of French elegance and skill. We meet with inexcusable rashness or misrepresentation on the one hand, and with subservient cowardice or fulsome adulation on the other. In our own country science is none too strong in criticism. With here and there healthy exceptions we have a good deal of paralysis in this direction. In a few quarters the indisposition to accept fair criticism is marked. But there is enough virility in our scientific community to accustom such weak brethren to this one of the phases of "the struggle for existence," by administering more criticism in judicious quantities so long as their cases may seem to require it.

——If the bureaus of the Government would send their return receipt with or in the publications they issue, every one concerned would be greatly accommodated. The return receipts would then be promptly returned, whereas as now sent at another time, it requires time and trouble to identify the package referred to, which sometime results in a failure to return the receipt as desired.

——We are sorry to see our cotemporary *Mind in Nature* admitting to its columns articles like that of Professor Piper on evolution. If the author had spent his time in studying field mice, or garter-snakes, or trout, or minnows, he would have learned to know something of the subject on which he writes so fluently.

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RECENT LITERATURE.

DE CANDOLLE'S ORIGIN OF CULTIVATED PLANTS.[1]—Two years ago the French edition of this book made its appearance, and was favorably received and noticed by the botanical world. It

[1] *International Scientific Series. Origin of Cultivated Plants.* By ALPHONSE DE CANDOLLE, foreign associate of the Academy of Sciences of the Institute of France, foreign member of the Royal Societies of London, Edinburgh and Dublin, of the Academies of St. Petersburg, Stockholm, Berlin, Munich, &c., &c. New York, D. Appleton & Co., 1, 3 and 5 Bond street. 1885, pp. x, 468.

PLATE XXVII.

Capybara, from South America.

was made the text (to some extent) of instructive articles by Gray and Trumbull, which appeared in the *American Journal of Science* during the year 1883, some of the matter of which has been incorporated by the author in the English edition which has now made an appearance. This edition is, therefore, somewhat more than a mere translation, and partakes of the nature of a new edition.

The purpose of the book may be given in the following paragraph in the preface: "I have always aimed at discovering the condition and the habitat of each species before it was cultivated. It was needful to this end to distinguish from among innumerable varieties that which should be regarded as the most ancient and to find out from what quarter of the globe it came. The problem is more difficult than it appears at first sight. In the last century and up to the middle of the present, authors made little account of it, and the most able have contributed to the propagation of erroneous ideas. I believe three out of four of Linnæus' indications of the original home of cultivated plants are incomplete or incorrect."

The book is divided into three parts. In the first we have a general discussion of the epochs of cultivation and of the method of discovering the origin of cultivated species. In the second part plants are taken up systematically and discussed as to their origin. Thus we have first those plants which are cultivated for their subterranean parts, next those cultivated for their stems or leaves, then those cultivated for their flowers or the organs which envelop them, next those cultivated for their fruits, and lastly those for their seeds. In part third we have interesting summaries and conclusions, accompanied with various tables of species.

In all the author has examined 247 species, of which 199 originated in the old world, 45 in the new world, with three whose origin has not yet been determined. "A noteworthy fact is the absence, in some countries, of indigenous cultivated plants. * * * The United States, in spite of its vast territory which will soon support hundreds of millions of inhabitants, only yields as nutritious plants worth cultivating the Jerusalem artichoke and the gourds;" a statement which apparently overlooks our excellent grapes which are derived from several native species, our blackberries, raspberries and strawberries.

On page 460 we find the remark: "I have not observed the slightest indication of an adaptation to cold. When the cultivation of a species advances towards the north (maize, flax, tobacco, etc.), it is explained by the production of early varieties, which can ripen before the cold season, or by the custom of cultivating in the north in summer the species which in the south are sown in winter." To this we apprehend our horticulturists will not assent. It may be true in the three examples cited, as well as for many others annuals, but what shall we say for the varieties

of the peach, pear and apple, which vary so much in their hardiness? Every fruit grower in the Northern States knows well that certain varieties of these trees will endure the winter while others will not. This may not be due to any adaptation to cold, but it certainly does not admit of the simple explanation given by the learned author. There have certainly been variations in the hardiness of cultivated plants, and these variations have, by judicious selection, made it possible for us to extend very considerably the range of the species.—*Charles E. Bessey.*

OUR LIVING WORLD.—Under this title Mr. Selmar Hess, of New York, is publishing in forty-two quarto numbers a popular work on natural history, which will be welcomed by young people on account of the abundant and showy illustrations.

The text is based on Rev. J. G. Wood's, and is anecdotal rather than scientific; it has been adapted for American readers by Dr. J. B. Holder. The wood-cuts are those which have appeared in Wood's book, also in Brehm's Thierleben, while the colored plates are oleographs reproduced by Prang from the exquisite chromo-lithographs of the great work of Brehm.

As a picture book of the animal creation, particularly of the vertebrates, it will prove attractive. The accompanying illustration of that strange animal the Capybara, the "native hog" of South America, the largest of existing rodents, will give an idea of the kind of illustrations used in the numbers we have thus far received. While, then, not specially authoritative or American in its plan or authorship, we doubt not that it will be welcomed by many as a readable "natural history."

As respects the classification adopted, the arrangement should be such as is generally followed by modern zoölogists. To place the marsupials between the land Carnivora and the seals is a violation of the simplest principles of classification. The Insectivora and bats are placed too near the primates, although it should be said that the position of these groups is in dispute.

The work will be issued in forty-two parts of forty-eight pages at fifty cents a part; it will contain forty-two oleographs and eighty-four full-page wood engraving. The paper and press-work are excellent.

MEMOIRS OF THE NATIONAL ACADEMY OF SCIENCES.—The third volume of the National Academy appeared in 1884 from the Government printing office. It is a quarto volume of 262 pages, and contains four memoirs read before the academy in 1884, under the following titles: Report of the Eclipse expedition to Caroline island, May, 1883; Experimental determination of wave-lengths in the invisible prismatic spectrum, by Professor S. P. Langley; On the subsidence of particles in liquids, by Professor W. H. Brewer; On the formation of a deaf variety of the human

PLATE XXVIII.

Vegetation on Caroline Island.

PLATE XXIX.

View on Caroline Island.

race, by A. Graham Bell. The greater part of the volume is devoted to the report of the eclipse expedition, the interest of which is enhanced by the photographs reproduced in its pages.

Caroline island is a genuine atoll, of the type described by Darwin and Dana; while the frontispiece gives a bird's-eye view of the low circular island, the four accompanying illustrations will convey an idea of the scenery of a Pacific atoll. The surface of the island is covered with palms and undergrowth, including a large number of young cocoa palms planted by the owners of the island, who keep a few people on the island to cultivate them. Beside the eclipse and other physical data, the botany of the island is described by Dr. W. S. Dixon, U.S.N., and Professor W. Trelease; Dr. Dixon also adds notes on the zoölogy of the island. The few butterflies have been named by Messrs. Arthur Butler and H. Stricker. The whole presents an interesting monograph of an atoll. Plates XXVIII–XXXI are from electrotypes of four of the views taken on the island.

DR. KRAUSS' SLAVIC CUSTOMS.—In his latest publication, the ethnologist Dr. Friedr. S. Krauss has taken up the subject of the tribal and family relations, of domestic life, courtship, marriage, married life, divorce, adoption, widowhood and hospitality among the Southern Slavs of the Balkan peninsula. From the title, "Sitte und Gebrauch der Südslaven" (Customs and uses among Southern Slavs)[1] we would certainly expect a full treatment of other subjects of popular life, also, as of legal customs, agriculture, pastoral pursuits, etc., included in the volume; but what is offered is so well marked with the stamp of learning and thoroughness that we do not grudge with the author for the rest, expecting to find it in subsequent volumes. The work was undertaken in 1883 under the auspices of the Vienna Anthropological Society, and carried out through the munificence of Baron Ferd. von Andrian-Werburg. A considerable literature already exists on the subject, as may be collected from the preface of another important work of Krauss (on the Folklore of Southern Slavs, a serial, of which two volumes have hitherto appeared), but the author is perfectly independent of his predecessors, has himself visited a large portion of the countries described, and speaks several of their dialects. The "Customs" are interspersed with many quotations from Slavic poets and from popular poems, of which the authors are unknown, sometimes also with quotations from the original languages. But he avoids on purpose ethnologic comparisons with facts taken from non-Slavic especially non-European institutions, as the conditions under which they originated may not always be the same as the ones observed at home. It is interesting to see how the tribe of the

[1] Sitte und Brauch der Südslaven. Nach heimischen gedruckten und ungedruckten quellen, von Dr. F. S. Krauss. Wien, 1885. A. Hölder, publisher. 8vo, xxvi and 681 pages.

ancient period (zupa or pleme) has gradually changed into the modern tribe, bratstvo or *brotherhood*, and in which manner all the family relations have assumed another shape also. It is true that many of these Slavic practices and customs are barbaric or have originated in a barbaric age, that some of the superstitions are exceedingly repulsive, and that the position of woman is far from what it ought to be or even from what it is now among the nations of Western Europe. Nevertheless a certain spirit of poetry hovers over these populations, which are isolated from the rush of the world's commerce and have been so long subject to the iron rule of the Turk. Their love for music, poetry, dance, mimicry and fairy tales lets them forget many of their tribulations and miseries of everyday life, and here in Krauss' book are gathered the most naïve and surprising utterances of the popular spirit. The long and useful alphabetical index was made by a young lady of the village of Mikanovci, whose name is mentioned in the preface.—*Albert S. Gatschet.*

KINGSLEY'S MADAM HOW AND MADAM WHY.[1]—Charles Kingsley was no ordinary man, and no ordinary writer, and the republication among the Globe Readings of his little work, Madam How and Madam Why, will doubtless be welcomed by many of the class of little ones for whom it was written. It is true that to an adult the impersonation of method and reason as "Madam How" and "Madam Why," and that of analysis and synthesis as giants seems too metaphorical and somewhat old-fashioned, yet the charm of the style cannot be denied. A deeper objection to the title is, that we do not know the "how" or "why" of anything—we name the forces which move nature's scenery, but we understand them not. No one knew this better than Charles Kingsley, as may be seen by what he has to say with regard to analysis and synthesis. As a book for American children the value of this treatise is impaired by the fact that all the allusions and illustrations are European, or rather British.

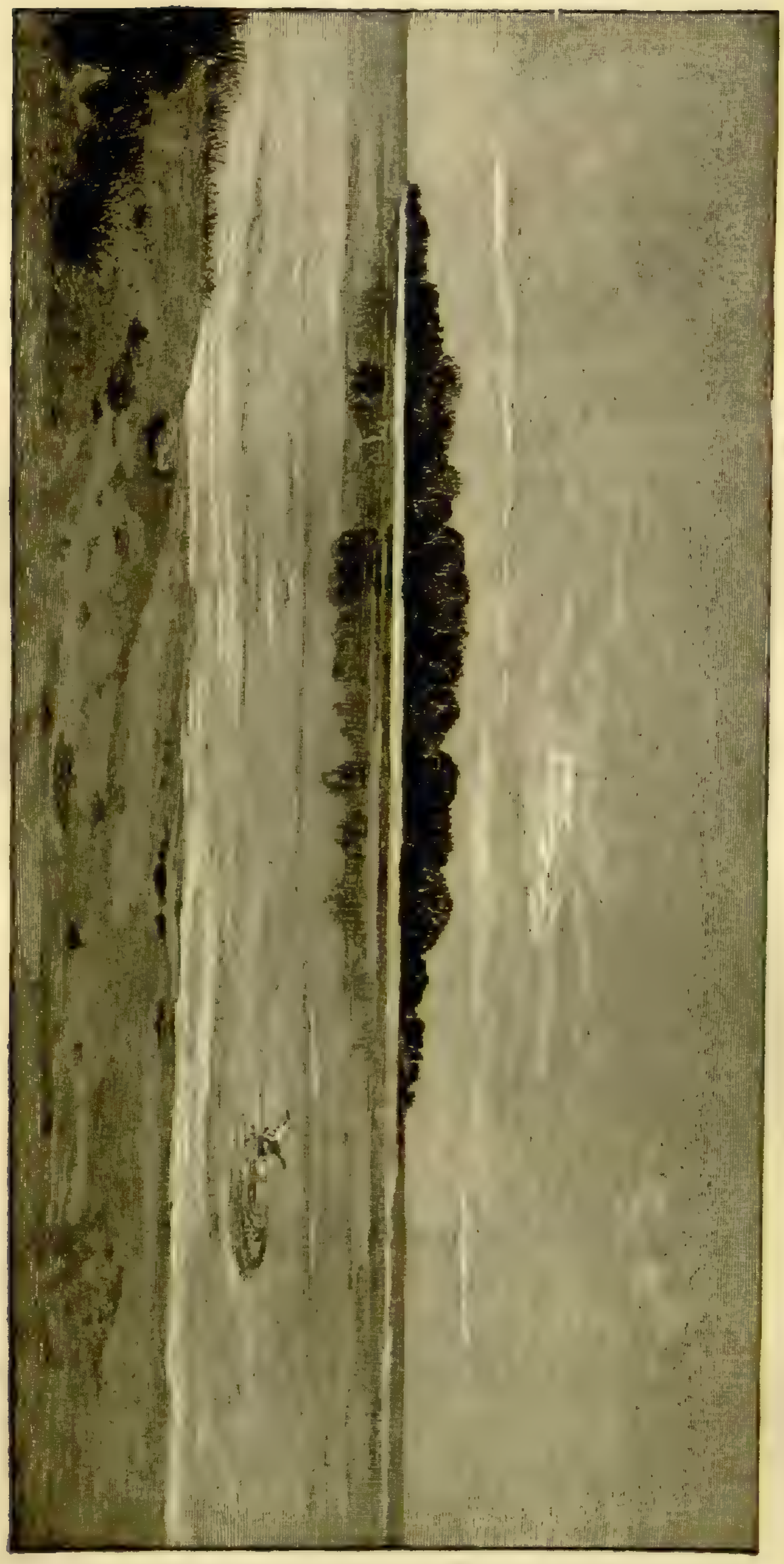
EYFERTH'S NATURGESCHICHTE DER MIKROSKOPISCHEN SUSSWASSER BEWOHNER.[2]—This is a handy book for the student of fresh-water microscopic life, animal and vegetable, and appears to be tolerably well brought up to date. The leading authorities are given, while short family descriptions, a key to the genera, and a brief characterization of the genera and of quite a large number of species give all that is necessary to enable the observer to place any particular form among its relatives. The work is well indexed, and illustrated by seven full-page plates.

[1] *Madam How and Madam Why, or First Lessons in Earth-lore for Children.* By CHARLES KINGSLEY. New York, Macmillan & Co., 1885.

[2] *Die Einfachsten Lebensformen des Thier-und Pflanzenreiches.* Naturgeschichte der Mikroskopischen Süsswasser bewohner. Bearbeitet von B. EYFERTH. Braunschweig, Von Goeritz und zu Putlitz, 1885.

View on Caroline Island.

PLATE XXXI.



Part of Caroline Island.

GATSCHET'S "A MIGRATION LEGEND OF THE CREEK INDIANS."[1] —This publication brings forward some scientific results obtained while studying the language and ethnology of the Creeks and their congeners. It commences with an account of the southern families of Indians, and concludes with the Kasi'hta migration legend. The settlements of the Creeks, their government, war customs, initiation and other ceremonies, history and dialect are described.

RECENT BOOKS AND PAMPHLETS.

Graf, L. von—Ueber einige Deformitäten an fossilen Crinoiden. Abd. der "Palæontographica," 1885. From the author.

Newberry, J. S.—The eroding power of ice. Rep. from School of Mines Quarterly, 1885. From the author.

Scudder, S H.—The earliest winged insects of America. 1885.

——Palæodictyoptera, or the affinities and classification of Palæozoic Hexapoda.

——Winged insects from a palæontological point of view. The last two from Mem. Bost. Soc. Nat. Hist., 1885. All from the author.

Gill, Th.—An account of the progress in zoölogy in the year 1883. From Smithsonian report, 1883. From the author.

Lord, E.—Comstock mining and miners. U. S. Geol. Surv., 1883. From the author.

Will, L.—Bildunggeschichte und Morphologischer Werth des Eies von *Nepa cinerea* L. und *Notonecta glauca* L. 1885. From the author.

Moseley, H. M.—Notes on the structure of Striatopora, Pocillopora, Corallium and Tubipora. 1882.

——On the pharynx of an unknown Holothurian of the family Dendrochirotæ. 1884.

——On the presence of eyes in the shells of certain Chitonidæ. 1884. All from the Quarterly Journal of Microscopical Science and from the author.

Mus. D'Hist. Nat.—Rapports Annuels de MM. les professeurs et chefs de service. Paris, 1882.

Fordice, M. W., and Eigenman, C. H.—A review of the American Eleotridinæ. Ext. Proc. Nat Sci. Phil., 1885. From the authors.

Brinton, D. G.—The lineal measures of the semi-civilized nations of Mexico and Central America. 1885. From the author.

Lyman, B. S.—A review of the Atlas of the western middle Pennsylvania anthracite field. Rep. Ming. Herald, Dec., 1884. From the author.

Shufeldt, R. W.—Variations in the form of the beak that take place during its growth in the short-tailed albatross. From the Auk, 1885.

——The osteology of *Amia calva*. Ext. Ann. Rep. Comm. Fish and Fisheries, 1885. Both from the author.

Holbrook, M. L.—The termination of the nerves in the liver.

——The structure of the muscles of the lobster. Both from the Rep. Proc. Amer. Soc. Micros., 1882, and from the author.

Lupton, N. T.—Meteoric iron from Coahuila, Mexico. Ext. Amer. Journ. of Science, Vol. XXIX, March, 1885. From the author.

Smith, Miss R.—Notes on fishes collected at San Cristobal, Lower California, by Mr. Chas. H. Townsend. Ext. Proc. U. S. Nat. Mus., 1884. From the author.

Fritsch, A.—Fauna der Gaskohle und der Kalksteine der Permformation Böhmens. Band II, Heft II. Prag, 1885.

——Ueber der Auffindung eines Menschenschädels im diluvialen Lehm von Strebichovic bei Schlan. Both from the author.

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[1] *A Migration Legend of the Creek Indians.* By ALBERT S. GATSCHET. Vol. I. Philadelphia, D. G. Brinton, 1884.

Fischer, J. G.—Ichthyologische und herpetologische Bemerkungen. Hamburg, 1885.

Goode, G. B.—Bulletin of the U. S. National Museum, No. 27. Descriptive catalogue constituting a report upon the exhibit of the fisheries and fish culture of the U. S. A., made at the London Fisheries Exhibiton, 1883. From the Dept. of the Interior.

Smithsonian Institution.—Bulletin of the Philosophical Society of Washington, Vol. VII, 1885. From the institution.

Mills, C. K.—Toner lectures, No. IX. Mental overwork and premature disease among public and professional men. 1885. From the author.

Taylor, W. B.—The refraction of sound. Ext. Smithsonian report, 1885. From the author.

Mason, O. T.—An account of the progress in anthropology in the year 1883. Ext. Smith. rep., 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*The Sanpo and the Irawadi.*—The chief paper in the May issue of the Proc. Roy. Geog. Society is upon the disputed question of the sources of the Irawadi. As no one has yet followed the Sanpo from Thibet downwards, it is still unproved whether it enters the Irawadi or the Brahmaputra. Mr. Robert Gordon opposes the commonly received idea by advocating the Irawadi view. He bases his belief upon the following points:

(1) The Salween, which flows to the east of the Irawadi, has been proved to rise north of latitude 30°, and thus the country which was formerly supposed to supply the Irawadi is now known to be the watershed of the Salween.

(2) The Irawadi at Bhamo, the point where it first became known to western geographers, is still one of the largest rivers in the world, containing probably two-thirds of its volume in the delta. The average discharge at the delta is about 521,794 millions of cubic yards, very nearly four-fifths of that of the Mississippi. But three-fourths of this vast discharge come down in the months of July, August and September. August has twenty-two per cent of the entire discharge, February and March only one and a half per cent. At Bhamo Mr. Gordon calculates the ordinary high-water capacity at 900,000 cubic feet per second.

(3) Chinese geographical annals, extending over twelve hundred years, and corroborated by the direct statements of French missionaries and others, give direct evidence that the Sanpo is the Irawadi, and maps, names of rivers, etc., give indirect evidence to the same effect.

Mr. Gordon quotes Count Szechenyi as follows: "Almost all the Tibetans who could furnish information about this country gave as an answer to my question, 'Where does this river come from?' 'From Lassa.' According to Chinese and Tibetan

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

sources, the Irawadi is no other than the lower course of the Tibetan Sanpo." Not only do the old Chinese geographers connect the Sanpo with the Irawadi, but the Chinese official map, made after the surveys of the French missionaries in the last century, does the same. The imperial geography of the Thung dynasty (617–907 A.D.) says that the great Kin-sha-Kiang is made up of two rivers and then passes by Mano and Tchenago (Bhamo and Tshempenago). It adds: "There is no doubt that this river is the Yaroo Sanpo of Thibet." The Emperor Kang-hi says that the Yaroo Sanpo enters the kingdom of Burma. The Yunnanese call the Upper Irawadi the Ta-Kin-sha-kiang, or Great Kin-sha river, while the Yang-tse-kiang is the Sui Kin-sha-kiang, or Little Kin-sha river. Ta-Kiu-kiang, the official Chinese name for the connecting link between the Sanpo and the Irawadi is identical with Nam-Kiu-long, the name given by the Shans who live upon it, both meaning the Great Kiu river. The explorations of Hindoo surveyors have carried the Sanpo to the east of the point where it was formerly supposed to enter Assam, but the lower courses of the affluents of the Brahmaputra were immediately twisted upon the maps so as to still show the union of the Sanpo with the Brahmaputra.

(4) It is impossible, on the supposition that the Zayul-Chu is the upper course of the Eastern Brahmaputra and the Sanpo that of the main branch of that river, to account for the volume of water in the Irawadi at Bhamo. A drainage area of from 5000 to 8000 square miles, which is all that could in such a case be left to the Irawadi, could not possibly yield so great a volume.

(5) The Zayul-Chu, which is said to be the Eastern Brahmaputra, may prove to be an affluent of the Irawadi. Mr. Gordon goes into elaborate arguments to show that Rima and Sama, places upon this river, are some thirty miles farther to the north-east than they are placed by Captain Wilcox (who did not visit them). In this half degree there is room for the Sanpo to flow to the Irawadi. The volume of the Zayul-Chu is greater than that of the Upper Brahmaputra.

(6) The Brahmaputra influents, even if the Sanpo is barred out by the range of mountains upon its southern and eastern borders, have basins sufficiently large to account for their dimensions. The Subansiri has 7000 square miles and a discharge of 240,000 cubic feet per second; the Eastern Brahmaputra 7000 square miles with 326,000 cubic feet, and the Dihong, which some believe to be the Sanpo, would without it have 7500 to 12,000 square miles, which, in the rainy climate of the southern slopes of the Himalayas, would account for its volume of 423,000 cubic feet per second.

In reply General J. T. Walker attacked particularly the arguments connected with the Zayul-Chu, certainly the weakest part of Mr. Gordon's paper.

Corea.—According to Mr. Carles there is in Corea a great disproportion between the numbers of the sexes, the males being the more numerous. There seems to be no evidence of female infanticide, but a greater number of deaths among girls in infancy. As a land of large hats Corea is unsurpassed. At Phyong Yang, a large town on the west coast, the hats worn by the poor women are baskets three and a half feet long, two and a half wide and two and a half deep, which conceal their faces as effectually as does the white cloak which women of a better class wear over their heads. The men wear a somewhat smaller basket of the same shape. It requires both hands to keep it in place. A similar structure, of a size but little larger, is used to cover fishing boats. The monument erected over the grave of a doctor of letters is the trunk of a tree painted like a barber's pole up to a height of some thirty feet. The top and branches are cut off, and on the summit is placed a slim carved dragon twenty feet long, with a head like that of an alligator. Mr. Carles reports, contrary to the statements of some other travelers, frequent evidences of mineral wealth.

M. de Mailly-Chalon's Journey.— M. de Mailly-Chalon gives in the Bulletin de la Société de Geographie a paper on a journey in Manchuria, from Peking through Kirin to Ninguta, and then along the Tiumen to Vladivostock. The journey the whole way was along the Corean frontier. From Vladirostock the travelers proceeded to Tomsk, thence to Samarkand, through Karshi to Bokhara, to the Amou-Darya at Charjni, down that river to Petro-Alexandrovsk, thence to Khiva, and lastly across the Kara-Kum to Merv, Sarakhs and Meshed.

OCEANICA.—*New Zealand.*—The April issue of the Proceedings of the Royal Geographical Society contains an account of a recent exploration of the King country of the North island, New Zealand. This country, containing some 10,000 square miles, is the Maori stronghold, and white men were, after the war of 1863–64, forbidden to enter under pain of death. It had thus never been surveyed prior to Mr. Kerry-Nicholl's expedition in 1883. In the course of 600 miles of travel twenty-five rivers not previously shown upon the maps, and two small lakes, were found; the sources of the four principal rivers of the colony, the Whanganui, Waikato, Whangaehu and Manganui-a-te-Ao, were traced; the hydrography of Lake Tanpo in relation to the four distinct watersheds flowing into it was examined; the volcano of Mt. Tongariro (9300 feet) and Mt. Ruapehu (9000 feet), the highest peak of the North island, were ascended, and the geological structure of the Kaimauawa mountains was made out. The region of Lake Taupo is an extended tableland varying from 1500 to 3000 feet in height. In its center lies Lake Taupo, covering over 300 sq. miles and 1175 feet above the sea. Seventeen

rivers, besides smaller streams, run into this lake, while the only river flowing out is the Waikato. The southern part of the tableland, known as the Rangipo plateau, rises to 3000 feet, while the part near Lake Taupo is about 2000 feet. Tongariro's active crater is nearly a mile in circuit. Ruapehu is among the largest extinct craters in the world, and is not a cone of scoria like Tongariro, but a gigantic crater of elevation with a base sixty miles around. The Kaimauawa mountains are almost in the center of the island, attain about 600 feet, and extend along a base of about eighty miles.

The Whangaehu river, which rises on the eastern side of Ruapehu, is one of the largest streams in the island, and descends by a series of grand cascades. The waters of the Upper Waikato burst from the sides of Ruapehu very near the Whangaehu, and the streams for a while run parallel, though afterwards they run in opposite directions. The finest forest in New Zealand is that of Te Rangikaika, which covers some 3000 square miles between Ruapehu and the west coast. Mr. Kerry-Nicholls reports that the Maori race is greatly on the decrease.

South America.—*Roraima.*—Particulars of Mr. Im Thurn's ascent of Roraima, with some illustrations, are given in a recent number of *Nature.* Koraima and Kukenam are separated by a wide gorge, and seem like two fortresses, with walls 1200 to 1800 feet high, built upon a mountain top 7000 feet in height. The north, east and west sides of Roraima are forest-crowned, but on the south and south-west it is for the most part devoid of trees up to 5890 feet. From here to the cliff-face the slope is steeper and covered with thick undergrowth with few large trees. The cliff of Roraima was ascended by following a ledge of rock running from the tree-covered part up to the summit. The botany of the slope was very interesting, but the top itself is covered with an extremely scanty and insignificant vegetation. There are several pools of water, and on all sides are grouped rocks of the strangest and most fantastic forms—portions of the solid sandstone on which they rest. Bushes three to six feet high, a few scrubby orchids, two species of thick-leafed ferns and a variety of the red Utricularia which grows below, comprised the botany. There is no soil, and no fossils were found.

The Saskatchewan Region.—G. M. Dawson (*Science*, April 24) describes the Saskatchewan country or that portion of the prairies which extends north of the northern boundary, as containing an approximate area of 300,000 square miles, and as less than 2000 feet above the sea-level, and thus lower than the corresponding portion of the continent further south. Parts of this area are characterized by scattered groves of aspen and other trees. The Red River valley has an altitude of 800 feet only, and from this level the surface slopes gradually upward at the rate of four to

five feet to the mile to the foot-hills. There the horizontal and unaltered strata of the Cretaceous and Laramie formations break against the base of the ancient rocks of the mountains into a series of sharp and nearly parallel flexures. In the central portion of the plains are a tumultuously hilly belt known as the Missouri Coteau, and also a line of indefinite elevations nearly parallel to the Coteau. The most remarkable difference between this region and that west of the Missouri is perhaps the extraordinary abundance of small lakes or "sloughs," evidently connected with the mantle of glacial drift. These usually occupy shallow basins without outlet, many are emptied by evaporation before autumn, and others from the same cause become more or less saline. The North and South Saskatchewan, Red Deer, Bow, and Belly rivers rise far back in the Rocky mountains, and while subject to considerable spring freshets, are generally not in full flood till June or July.

The Xingu. — Dr. Clauss recently gave, before the Munich Geographical Society, an account of his explorations of the watershed between the Paraguay and the Amazon. This watershed is 300 to 400 meters high, and is a savannah broken up by forests along the water courses. The watersheds between the tributaries of the Amazons in this region are unknown. Brazilian geographers direct the upper course of the Xingu to the Tapajos, and put the source of the former under 11° S. lat. Eight days after the expedition had crossed the last tributary of the Tapajos they reached a large river which they named the Rio Batovy, and descended in bark canoes to the Xingu. The inhabitants of some Bucairi villages were found to be utterly ignorant of metals. From 8° to 3° S. lat. the Xingu falls 200 meters in a series of cataracts which were successfully passed under the guidance of the Yaruna Indians.

EUROPE.—Dr. F. Suenonius believes that the word "lapp" is derived from *lappa* or *lappah*, "cave" or "recess," a name given by the Scandinavians because the Lapps of earlier times lived in caves or recesses. The mountains of Swedish Lapland are partly Alpine, composed of hornblende, gabbro and eklogite, but principally low rounded "grass" mountains of schist impregnated with chalk. The highest parts of Swedish Lapland are around the sources of the Rapaädnos and west of Lake Paijasjärvi, and in these regions the largest Swedish glaciers occur. About 180 square kilometers are covered with "eternal" ice, reaching several hundred feet in depth. The surface area of the lakes is about one-third of Swedish Lapland.

The Hungarian Society of Geography is engaged in organizing a Magyar expedition for the exploration of the region round the Urals, especially the Baskir country, where Uralo-Altaú peoples are disappearing.

AFRICA.—*African News.*—Dr. Oscar Lenz was sent by the Imperial Geographical Society of Vienna to explore the water-shed between the Nile and the Congo. He started in May. ——The Austrian explorers, Dr. Paulitschke and Dr. von Hardegger have returned from the Gallas country. They were amicably received by the Egyptian governor of Harrar. On their return (March 25, 1885) they found Zeila half in ruins.——A government commission has inspected and reported upon the Tunisian forests. In the districts south of the Medjerda valley the so-called forests are a mere brushwood with groups of larger trees, but on the Krumis mountains to the north, exist magnificent forests with trees equal in size to those of France, including cork trees and *Quercus mirbockii.* One forest covers 100,000 hectares.

GEOLOGY AND PALÆONTOLOGY.

THE MAMMALIA OF THE OLIGOCENE OF BUENOS AYRES.[1]—This memoir, by M. Ameghino, is one of much importance to the history of the Mammalia, and especially to the history of the Pampean and recent faunæ of the neotropical realm. Ever since M. Bravard announced the existence of species of Palæotherium and Anoplotherium in strata within the limits of the Argentine Confederation, the curiosity of palæontologists has been awaiting an explanation of a statement apparently so at variance with the known facts of the science. M. Ameghino, aided by the labors of Professor Scalabrini, has fortunately resolved this problem, and with it has set before us a record of uncommon interest to the students of the Mammalia and of their evolution.

The strata which have yielded the collections studied, are situated on the Parana river. The number of species obtained is sixty-two, which are referred to forty genera, which are distributed into orders as follows: Cetacea 3; Carnivora 3; Artiodactyla 2; Perissodactyla 5; Toxodontia 4; Rodentia 11; Edentata 17. Of these forty genera, sixteen also occur in the Pampean fauna.

Of these forms it is not to be supposed that all have been fully elucidated and their places finally ascertained. This is especially true of the ungulate orders, where the much-needed determination of the foot structures has not yet been made. We may therefore wait until this is done before accepting the reference of the genus Brachytherium Amegh. to the Anoplotheriidæ, or Ribodon Amegh. to the Tapiridæ. The references of the other genera to families characteristically Pampean, is so highly probable as to require less exhaustive demonstration to command belief. It is in these groups that the most interesting contribu-

[1] Nuevos Restos de Mamiferos Fósiles Oligocenos Recogidos por el Prof. Pedro Scalabrini y pertenencientes al Museo provincial de la Ciudad del Parana; por Florentino Ameghino. Buenos Ayres, 1885, pp. 204. (Extract from the Bulletin Nat'l Academy Sciences, Cordoba, VIII, p. 5.)

tions to the history of the evolution of the well-known Pampæan genera have been made. Thus a series is traced backwards in time from Toxodon, which shows that in the more ancient types the dentition was less rodent-like, since the molars were shorter and the canines larger. This adds evidence to the opinion which the writer has reached, that rodent-like types are not primitive but derivative.[1] Protypotherium is believed by Ameghino to be the ancestor of Mesotherium. Scalabrintherium stands in the same relation to Macrauchenia. As to the Edentata, the cases of evident ancestral relation are numerous, and are expressed in such names as Promegatherium Amegh., Promylodon Amegh., Palæhoplophorus Amegh., and Protoglyptodon Amegh. Perhaps the most interesting fact in this connection is the existence of more or less enamel in bands on the teeth of the gravigrades of this formation, proving that the history of the dentition of the Edentata has been one of degradation, as the writer had already concluded before reading M. Ameghino's memoir.[2] This fact is confirmatory of the theory of descent of the Edentata from the Tæniodonta, proposed by myself in 1877.[3]

The rarity of Carnivora in this formation is remarkable, there being but two terrestrial forms, Cynonasua Amegh. and ? Arctotherium. The rodents are remarkably numerous, twenty-one species being described. Important among these is the genus Megamys, which includes the largest species of the order, *M. patagoniensis* Laur., and which Ameghino places in the Chinchillidæ. Twelve of the species are referred to the Caviidæ.

We do not understand the ground of reference of this formation to the Oligocene. The cacophony of many of the new names proposed is somewhat surprising. The Latin languages of Europe are the most euphonious, but some of the naturalists of those races appear in latter years to have forgotten their cunning.

The further elucidation of this fauna, by so able an anatomist as M. Ameghino, will be awaited with much interest.—*E. D. Cope.*

On the Gampsonychidæ, an undescribed family of fossil Schizopod Crustacea.[4]—The opportunity of examining at my leisure about a dozen specimens of *Palæocaris typus* of Meek and Worthen, kindly afforded me by Messrs. R. D. Lacoe and J. C. Carr, has enabled me to work out some characters of this genus not mentioned by the original describers. The study of these specimens has led me to compare the genus with Gampsonyx, and the result has led to the formation of a family or higher group for the two genera, which should probably stand at the base of the Schizopoda, while also serving to bridge over the chasm

[1] See Naturalist, 1885, p. 347, for the origin of the Rodentia from the Tillodonta, etc.

[2] See Naturalist, 1885, p. 352, and 1884, p. 1257.

[3] Report Expl. Surv. W. 100 Mer., G. M. Wheeler, IV, pt. II, p. 158.

[4] Read at the April meeting of the National Academy of Sciences.

existing between the thoracostracous suborders Syncarida and Schizopoda.

Palæocaris was first described by Messrs. Meek and Worthen in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1865, p. 48, from specimens occurring in claystone nodules in the lower part of the true coal measures, at Mazon creek, Morris, Grundy county, Illinois. Afterwards in the third volume of the Report of the Geological Survey of Illinois, 1868, the same authors figured the fossils and expressed themselves as follows regarding its affinities: "Hence it would seem to present something of a combination of decapod (macruran) and tetradecapod characters. That is, it possesses the caudal appendages, anteriorly-directed thoracic legs, the antennæ (some of the specimens appear also to show basal scales to the outer antennæ), and general aspect of a macruran, with the distinct head, divided thorax (without a carapace) and seven pairs of thoracic legs of a tetradecapod. We have not been able to see its eyes, but from its other decapod characters, and its analogy to Gampsonyx, which is said by von Meyer to have pedunculated or, at any rate, movable eyes, we are strongly inclined to believe that our fossil will be found to agree with Gampsonyx in this character also.

"It therefore becomes a matter of interest to determine to which of the subclasses, decapods or tetradecapods, it really belongs. That it belongs rather near Gampsonyx, though not to the same subordinate section (Schizopoda), there can be little doubt. Hence these two forms apparently fall naturally into the same family. Professor Jordan and Mr. Meyer seem to have regarded Gampsonyx as a tetradecapod, connected with the Amphipoda, but also possessing macrural decapod affinities. Professor Dana, however, regards it as a low type of Macrura belonging to the section Schizopoda. He and Dr. Stimpson, to whom we sent sketches of our better specimens of Palæocaris, concur in the opinion, judging from all its characters yet known, that it is a low embryonic type of the Macrura, in which the carapace is not developed.

"Generically it is separated from Gampsonyx, figures of which (cuts *C* and *D*) we have added for comparison, not only in the nature of its caudal appendages, but in the more important character of having its thoracic legs simple, and not bifid as in the Schizopoda."

In our specimens we were able to detect well-marked narrow lanceolate oval breeding lamellæ on eight pairs of appendages.

It should be observed that the breeding lamellæ are in part represented in Meek and Worthen's figure, but not referred to in their description; they are also partly represented in their copy of Jordan and Mr. Meyer's figure of *Gampsonyx fimbriatus;* in the latter there is also present what is apparently a large coarsely-spined mandibular palpus, somewhat like that in the male of the existing deep-sea schizopod, *Petalophthalmus armatus*, described

by Willemoes-Suhm.[1] In the females, however, the palpus is small and unarmed, and it is probable that all my specimens of Palæotypus are females, since most of them have breeding lamellæ. In the figure of Gampsonyx referred to, the thoracic legs themselves, irrespective of the breeding lamellæ, are represented as biramous, and the two rami are drawn as of nearly equal length; it is probable that there has been a mistake in drawing the legs, as in none of the existing schizopods, such as Mysis and allies, Euphausia, Gnathophausia, Petalopthalmus or Chalaraspis, are the legs thus thrice divided. It is to be hoped that the fossil itself will be examined anew with regard to this important point.

It is sufficiently evident, however, that Gampsonyx and Palæocaris are closely allied forms, and as suggested by Messrs. Meek and Worthen, should fall into the same family, which may be called Gampsonychidæ. The principal character which separates this group from all other schizopods is the entire absence of a carapace.

It is worthy of notice, however, that the size of the carapace is very variable in the Schizopoda, and in the genus Petalophthalmus there is a great discrepancy in the two sexes; in the female it covers the entire thorax, while in the male it is remarkably small, subtriangular, leaving the two hinder thoracic segments entirely exposed, as well as the sides of the two segments in front. In the large size and oval-lanceolate shape of the breeding lamellæ, both of the gnathopods (maxillipedes) and thoracic feet, the Gampsonychidæ agree with Petalophthalmus, in which they are large and broad. In the shape of the telson and the comparative size and proportions of the last pair of abdominal appendages there is a close relationship in the Gampsonychidæ to the schizopod genera Petalophthalmus and Chalaraspis, especially the latter genus, in which the telson is rounded at the end, while the two rami are more as in Petalophthalmus, though broader. The other biramous abdominal appendages in the Gampsonychidæ are truly schizopodal.

Classifying the Schizopoda by the carapace, there would seem to be three groups, as follows:

I. Carapace absent..... *Gampsonychidæ.*
II. Carapace free, varying in size.. *Gnathophausia. Petalophthalamus, Chalaraspis.*
III. Carapace fastened to the thorax..... *Mysis, Lophogaster, Cephanoia.*

But I should agree with Willemoes-Suhm that this is not a natural genealogical classification, and throwing out the Nebaliadæ, which we have endeavored to show belong to a distinct order of Crustacea, the families of schizopods may be enumerated thus, all having seven abdominal segments:

Carapace absent, 6 pairs of thoracic legs.....	I.	*Gampsonychidæ.*
Carapace well developed, 6 pairs of thoracic legs.....	II.	*Mysidæ.*
" " " 8 " " "	III.	*Euphausiidæ.*
" " " 4 " " "	IV.	*Chalaraspidæ.*
" " " 7 " " "	V.	*Lophogastridæ.*

[1] On some Atlantic Crustacea from the *Challenger* expedition. By Dr. R. von Willemoes-Suhm. Linnæan Transactions. Zoölogy. Vol. I, p. 23, 1874.

When we compare the Gampsonychidæ with the Syncaridæ (Acanthotelson), we see that both groups have the same number of body-segments, and that both lack a carapace; and thus while the Gampsonychidæ are the ancestors of living schizopods, the group as a whole probably descended from Acanthotelson, which is thus a truly synthetic form, standing in an ancestral relation to all the Thoracostraca, while it also suggests that the sessile-eyed and stalk-eyed Crustacea may have had a common parentage.

GEOLOGICAL NEWS.—*Silurian.*—Various studies by W. C. Brogger, upon the Silurian strata of Norway and their contained fossils, are published in the Magazin fur Naturvidenskaberne, Christiania, 1878–1882–1884, and furnish new data for a comparison between the Scandinavian, German and English Silurian.

Devonian.—P. Wenjukoff has published (in Russian) a work upon the Devonian strata of European Russia, with a table of comparison with the beds of Belgium and Eifel. It appears that the Russian beds belong to the Middle and Upper Devonian.

Carboniferous.—MM. B. Renault and E. E. Bertrand have found incontestable proof of the existence of fungi in Carboniferous times. In the tissue of the seed of a conifer of this epoch (*Spherospermum oblongum*) the mycelium of a fungus was found, consisting of threads which were lengthened out or irregularly bunched together, according to the size of the cellules in which they were developed. The cellules of the hypla may be entirely or totally transformed into sporangia, in the latter case the part which touches a sporangium is furnished with a cuticle. Two sporangia are often thus separated by a cuticle cellule. The sporangia are ovoid, are swollen upon the side of the orifice. They are usually empty. The Grilletia are thus remarkable for their sporangia without a neck and without an operculum, and for their habitat in the seeds of gymnosperms. They must be placed near Aphanistis, Catenaria and Ancylistis.——The annals of the Belgium Royal Museum of Natural History, 1883, contain the fourth part of De Koninck's studies of the fauna of the Carboniferous Limestone of Belgium. This part is devoted to the Gastropods. Among new species are numerous Calyptræidæ, four of Helminthochiton, four Dentaliidæ and a small Hyolithes.

Mesozoic.—M. Bleicher (Bull. Soc. Geol. de Fr.) gives a stratigraphical study of the iron beds of Lorraine, belonging to the Upper Lias and Lower Oolite. From a comparison it appears that there is a great agreement between these beds in France and Germany and the corresponding ones in England.——M. Neumeyer (Denksch. d. kais. Acad. Wien, 1883) contributes his views upon climatic zones during the Jurassic and Cretaceous periods. In the first chapter, "Theory of the Climate of the Past," he combats the usual idea that before the beginning of the Tertiary the entire earth enjoyed an equable warm temperature through the

influence of the interior heat. In the next chapter is brought together all previous knowledge of climatic zones in Jurassic times, and the next treats of the characteristics of an Alpine Jura and a mid-European Jura. This is followed by a chapter upon the distinguishing features of an Alpine and a Mediterranean Neocomian. He finally thus classifies the zoögeographical provinces of Jurassic and Cretaceous times:

I. Boreal Zone.

1. Arctic province.
2. Russian "
3. Himalayan "

II. North Temperate Zone.

1. Mid-European province.
2. Caspian "
3. Punjab "
4. Californian "

III. Equatorial Zone.

1. Alpine (Mediterranean) province.
2. Crimo-Caucasic "
3. South Indian "
4. Ethiopian "
5. Columbian "
5*a*. Caribbean "
6. Peruvian "

IV. South Temperate Zone.

1. Chilian province.
2. New Zealand "
3. Australian "
4. Cape "

Tertiary.—Numerous plant impressions, together with remains of *Sus major*, *Hipparion gracile*, *Castor jægeri*, etc., have been found in the lignite beds which are interstratified with the lower layers of the Miocene of Cerdagne, an ancient lacustrine basin on the southern slope of the Pyrenees.——F. Fontannes writes of a new exposure of Miocene strata near Lisbon (Portugal), and describes the fossils found there, including a species of swimming-crab (*Achelous delgadoi*), the first representative of this tropical genus yet found in the Miocene. It occurs abundantly in the strata containing *Venus ribeiroi*.——"The classification and palæontology of the United States tertiary deposits." Under this head a note has been published in the number of June 12, of this journal, on the first part of my article, "The genealogy and the age of the species in the Southern Old-tertiary," *American Journal of Science*, June, 1885. I refer those readers of THE NATURALIST who are interested in this matter to the second part of this article, which will appear in the July number of the same journal.—*Dr. Otto Meyer, Yale College Museum, New Haven, Conn., June 15, 1885.*

Quaternary.—M. Stanislaus Meunier has described a Quaternary flint from the valley of Loing, forty-five mm. in diameter, containing not only a movable nucleus of stone, but a quantity of water. Such cases are well-known among quartz or concretions from amygdaloid rocks, but the example is said by M. Meunier to be unique among flints. The water must have come from the Quaternary bed in which the flint, itself of Cretaceous age, was lying, and must have penetrated the stone by permeating the silex.

MINERALOGY AND PETROGRAPHY.[1]

THE CLASSIFICATION OF NATURAL SILICATES.[2]—The author discussed the history of mineralogy, and noticed the method of classifying mineral species based solely on physical characters, which makes mineralogy a division of natural history. He then proceeded to consider the method of those who have arranged mineral species in accordance with the results of chemical analysis, disregarding or giving a subordinate place to physical characters. A true philosophy, it was contended, should keep in view both of these methods; the chemical cannot be separated from the physical study of species, and a thorough knowledge of the chemical constitution of these will show that their physical characters are intimately related thereto, and will lead to a natural system in mineralogy.

The author, in attempting the elaboration of such a system, begins by showing, in the present paper, its application to natural silicates. These he regards as polysilicates of high equivalent weights, in accordance with the view put forward by him in 1853, when wollastonite was referred to a polysilicic acid with $11SiO_2$, and pyroxene to one with $14SiO_2$, or some simple multiple of these numbers. In such compounds the degree of complexity of the molecule is shown by the relation to space of the chemical equivalent or, in other words, by its volume. To arrive at a term of comparison for this in species of various and unknown degrees of complexity the author deduces for each silicate the mean equivalent weight of its atomic unit, corresponding to an atom of NaCl, for which purpose H_2O and CaO are divided by two, SiO_2 by four, and Al_2O_3 by six. The mean unit-weight, P, thus deduced from any arbitrary chemical formula, divided by the specific gravity of the species, gives the volume of the unit V, which serves to show for different species the relative condensation of the molecule. The hardness and the chemical relations of species will be found to vary with the unit-volume.

For example, the simplest atomic ratio representing the two species meionite and zoisite (which have the same centesimal composition), is (ca.al2.si3) o6; the small letters representing atoms, and o = 8. This gives an equivalent of 107, which divided by six yields for the mean atomic weight of the unit in both of these species P = 17.83. Dividing this latter number by 2.7, as the specific gravity of meionite, we have for the atomic volume in this species V = 6.60, and by 3.4, as the specific gravity of zoisite, V = 5.24. The true formulas and equivalent weights of these polysilicates must be deduced from a comparison of their specific gravities with those of species whose equivalent weights are otherwise determined. Meanwhile it will be seen that zoisite, with the lower value of V or, in other words, the more condensed

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore.

[2] Abstract of a paper read before the Nat. Acad. Sciences, April 21, 1885.

molecule, differs from the less condensed meionite by its greater hardness and its superior resistance to the action of acids.

From a consideration of the constitution thus assigned to silicates, it follows that the comparatively simple ratios generally deduced for the silica and the various bases are, in many cases, but approximations to the more complex ratios really existing. These, from the frequent impurities of natural silicates, can seldom be fixed with exactness, though with sufficient precision to give very nearly the values of P and V, which latter serves to determine the place of the species in the natural system of classification.

Water being an element universally distributed, its presence or absence in a silicate becomes of subordinate importance in determining alike the genesis and the natural affinities of species, so that the water-ratios are omitted in the tables of classification (which were shown), wherein the various natural silicates are, from the chemical side, considered with regard to the atomic ratios of fixed bases to each other and to the silica. There are genetic reasons for separating silicates of sesquioxyd bases, like alumina from protoxyd-silicates. The former of these constitute the class of Persilicates, and the latter the Protosilicates; those containing both protoxyds and sesquioxyds being designated Protopersilicates. Ferric oxyd and zirconia are classed with alumina as sesquioxyds, while titanic and boric oxyds in silicates are counted with the silica in determining the atomic ratios.

In the table of the Protosilicates, and in that of the Persilicates, both hydrous and anhydrous, the generally accepted ratios of the fixed bases to the silica are noted, but in that of the Protopersilicates regard is had to the more important ratios of sesquioxyds and fixed peroxyds to each other, inasmuch as the ratio of silica to both of these is found to vary greatly in closely related species, as may be seen in zeolites, feldspars, scapolites and micas. In these tables the three great classes of silicates are each arranged in groups, with primary reference to physical characters. Thus for Protosilicates we have in parallel columns, Pectolitoid, Spathoid, Adamantoid and Ophitoid, with each of which the range of values for V is given, while in an adjacent column to the left are inscribed the approximate atomic ratios of fixed protoxyds to silica. Among pectolitoids are included with pectolite, apophyllite and datolite, hydrohodonite, pyrosmalite, dioptase, calamine, cerite, thorite, etc. The spathoids embrace willemite, tephroite, gadolinite, helvite, leucophanite, wollastonite and tscheffkinite; the adamantoids, chondrodite, chrysolite, phenacite, bertrandite, hornblende, pyroxene, titanite, and danburite, while the ophitoids include various hydrous silicates, of which villarsite, serpentine and talc are representatives.

The Protopersilicates, in like manner, are grouped under the heads of Zeolitoid, Spathoid, Adamantoid and Phylloid, a subor-

dinate division to the latter being designated Pinitoid. In a column to the left are given the atomic ratios of sesquioxyds and fixed peroxyds, the silica being variable. The zeolitoids include besides the zeolites proper, forestite, prehnite, catapleiite, etc. Under the spathoids of this class are placed petalite, all feldspars and feldspathides, including iolite and sodalite, the scapolites, barylite, milarite, gehlenite, sarcolite, melilite, wöhlerite and eudialyte. The adamantoids include keilhauite, schorlomite, ilvaite, idocrase, garnet, allanite, beryl, euclase, ardennite, axinite, epidote, zoisite, jadeite, spodumene, sapphirine, staurolite and the various tourmalines. In the phylloids are included the whole of the micas from phlogopite and biotite, through seybertite, chloritoid, lepidolite and margarite to damourite and the muscovites. With the phylloids, and near the magnesian micas, come the various chlorites, while parallel with the non-magnesian or muscovite micas are placed the pinitoids, including besides pinite, or geïseckite, jollyte, fahlunite, bravaïsite, cossaite, gümbellite, etc.

The Persilicates are all gathered in two columns under the heads of Kaolinoid and Adamantoid, the received ratios of the fixed bases and silica being given in an adjacent column. The kaolinoids include the various hydrous silicates of alumina from the highly basic schrötterite, through kaolinite and halloysite, to to cimolite and smectite. With these are placed chloropal and also pyrophyllite. The adamantoid persilicates include besides dumortierite, fibrolite, cyanite and bucholzite, andalusite, topaz, the zircons and anthosiderite.

The relations of fluorine in silicates like topaz and chrondrodite, of chlorine in scapolites and sodalite; and of sulphur in lapis-lazuli, helvite and danalite are discussed at length by the author. Tables showing the values of P and V, together with the simplest atomic formulas deduced from chemical analysis are given for most well known silicates. The discussion of the equivalent weights of these species, and their definite place in a chemical classification of polysilicates is noticed, but is left for future consideration.

If we regard the silicates as constituting a natural order, the three groups already noticed may be called suborders; A. Protosilicates; B. Protopersilicates; C. Persilicates. The divisions of these designated Pectolitoid, Zeolitoid, Spathoid, Adamantoid, Phylloid, Ophitoid, etc., will constitute tribes. The tribal characters of the spathoids and the adamantoids being repeated in the suborders, we have A. and B. Spathoids and A. B. and C. Adamantoids. The subdivisions of these tribes into families, genera and species cannot here be discussed. The genus feldspar, including anorthite, albite and perhaps iolite, with other genera, some of which are represented respectively by orthoclase, by leucite, and by sodalite, will constitute the family of the feldspathides. The families of the micas and the pyroxenides in like manner will each include several genera, having different values for V.

The application of the principles above defined to carbonates, and the reference of the various carbon-spars to different polycarbonates, was long ago shown by the author in his papers already noticed. The extension of like views to all liquid and solid inorganic species, both natural and artificial, is but a matter of detail and labor, and when fully carried out will be the basis of a new chemistry.—*T. Sterry Hunt.*

MINERALOGICAL NEWS.—Dr. Carl Hintze contributes a paper on the chemical significance of crystallography, an address delivered on the occasion of his installment as "privatdocent" at the University of Bonn.[1]——F. Rinne[2] has investigated the crystallography of zincite on some artificial crystals from the zinc-furnaces of Lerbach in the Hartz, and finds the system hexagonal and axial ratio 1 : 1.621934. On the ground of etched figures produced by cold dilute hydrochloric acid as well as from the habit of the crystals, the author assumes that the mineral is hemimorphic with a decided resemblance to wurtzite.——Dr. Schuster,[3] of Vienna, describes an occurrence of fichtelite from a new locality—Salzendeich. It is found in monoclinic crystals $1\frac{1}{2}^{cm}$ in length. Twins are not uncommon, the twinning plane being the basal pinacoid.——H. A. Miers[4] gives a valuable monograph on the species bournonite, in which he adds to the list of fifty forms observed by former authors twenty-nine new ones of undoubted character, while twenty-one others are mentioned as doubtful. The same writer finds the hexoctahedron $\frac{3}{2} O \frac{9}{8}$ (986) on certain cuprite crystals from Cornwall, Eng., developed in accordance with the gyroidal hemihedrism of the regular system.[5] This has before only been once observed on artificial crystals of sal ammoniac by Tschermak.[6]——L. McCay[7] proves both by analysis and determination of specific gravity that a massive as well as a crystallized variety of safflorite (Co, Fe) As_2 occurs in nature. The specimens which he examined were from Schneeberg, in Saxony, where this substance is called by the miners "schlackenkobalt."——Messrs. Diller and Clarke[8] give the results of a microscopic and chemical study of the change of the topaz occurring at Stoneham, Me., to damourite. The alteration takes place along cracks in the topaz crystal, the transition, however, from the one mineral to the other being always abrupt. No intermediate product was observed. Professor Clarke appends some simple looking

[1] Ueber die Bedeutung krystallographischer Forschung für die Chemie. Habilitationsrede. Bonn, 1884.
[2] Neues Jahrbuch für Min., etc., 1884, II, p. 164.
[3] Ischermak's Min. und Pet. Mitth., II, 1885, p. 88.
[4] Mineralogical Magazine, VI. p. 69, 1884.
[5] Am. Journ. Science, 1885, May, p. 420.
[6] Tschermak's Min. und Petr. Mitth., 1881, p. 331.
[7] Am. Jour. Science, 1885, May, p. 369.
[8] Am. Jour. Science, May, 1885, p. 378.

structural formulæ for certain silicate minerals which are most interesting if demonstrable.—Tiffany & Co., of New York, have just published an illustrated catalogue of their collection of rough diamonds which so admirably exhibits all the phases in the crystallography of this interesting mineral. The collection embraces 904 stones weighing over 1876 karats, of these twenty-two are in the rock.——Dr. Konrad Oebbeke,[1] of Munich, has published some studies made upon crystallized minerals found in the andesites of Mt. Dore in Central France. Hypersthene, hornblende and pseudo-brookite receive especial attention.—— K. von Chrustschoff,[2] in the second part of his paper on secondary glass-inclusions finds that those observed in quartz fragments which have been imbedded in a liquid magma are due in all cases either to the infiltration of this magma into fissures or to the melting of some more easily fusible mineral which existed as an inclusion in the quartz before its imprisonment in the magma.——Professor Roland Irving, of Madison, Wis., in charge of the U. S. Geological Survey of the Archæan rocks of the Northwest, has just issued a most interesting paper on secondary enlargements of mineral fragments in certain rocks.[3] A large number of observations show the widespread growth of rounded quartz grains by subsequent deposits of silica, which acts as their cement. This phenomenon, which was first described by Sorby and has since received considerable attention from A. A. Young, Irving, and others, plays a most important rôle in the change of sandstones to quartzites. The enlargement in the same manner of feldspar grains by secondary deposits of feldspar substance was recently observed for the first time by Professor C. A. Vanhise, of Madison, whose paper is appended to the present work. The facts described are illustrated by a large number of excellent colored plates.

BOTANY.[4]

Branching of Pteris aquilina.—Much has been written on the structure of this well-known fern, but the relation of the fibro-vascular system of the stipe to that of the rhizome does not seem to have been traced. The widely-creeping rhizome *A* contains at the center two strong bands of sclerenchyma with two fibro-vascular bundles or rows of bundles between them, the whole surrounded by a ring of bundles much as in Fig. 1 *B*. In branching division occurs on a line crossing both bands of sclerenchyma, setting off to the branch a portion of both central bundles

[1] Bull. Soc. min. de France, 1885.

[2] Tschermak's Min. und Pet. Mitth., VIS, 1885, p. 64.

[3] Bulletin of the U. S. Geol. Survey, No. 8. Washington, Govt. printing office. 1884. (Price ten cents.)

[4] Edited by Professor Charles E. Bessey, Lincoln, Nebraska.

and of the outer ring, the divided bundle-ring afterwards closing up, leaving the arrangement the same as before.

If, however, the branch is to be a frond, a connection is soon formed between the two sclerenchyma bands, dividing both bundles or rows of bundles between them. The beginning of this connecting band is seen in Fig. 1 *B*, a section at the base of the stipe just above the point of attachment. When this connection is completed the bundles all lie in one continuous, though distorted ring, the enclosed sclerenchyma occupying the place of pith. From this point upward the band of sclerenchyma which lies on the anterior side of the stipe gradually diminishes

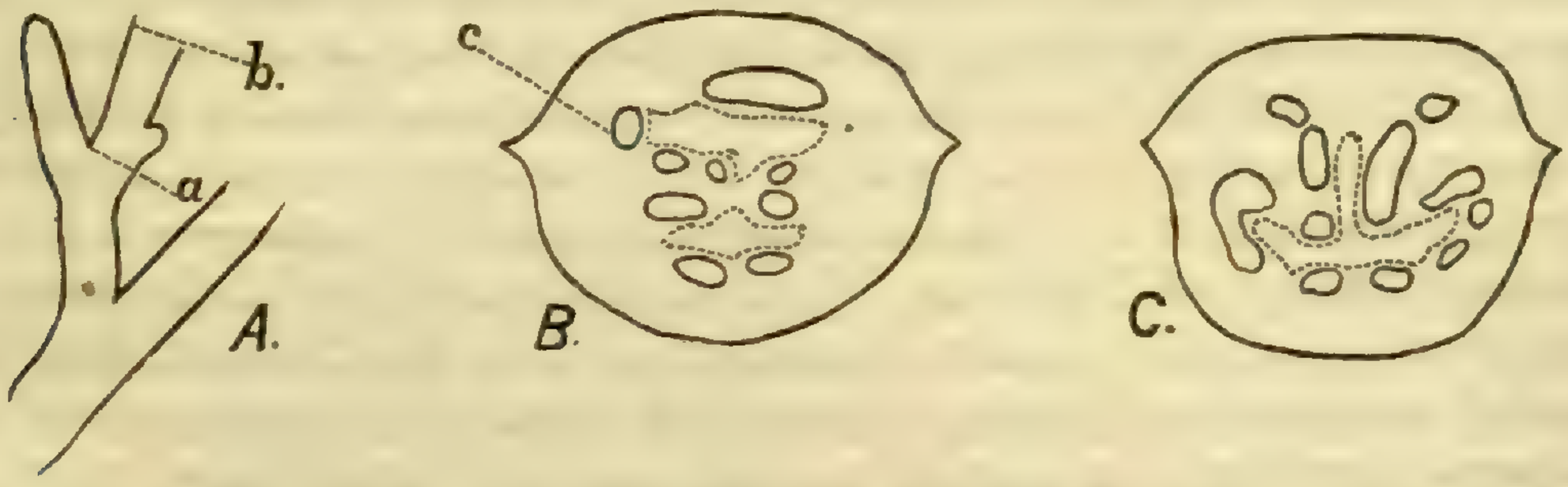


FIG. 1.—*A*, outline of a rhizome with base of stipe, *a–b*; *B*, a horizontal section at point *a*; *c*, a bundle which divides; *C*, horizontal section at the point *b*. The areas within the dotted lines are sclerenchyma, the others fibro-vascular bundles. *A* about one-half, *B* and *C* about twice natural size.

in size and finally disappears, while the one on the opposite side becomes broader, its edges bend forward and the bundles bordering upon it divide and increase in number. During these changes the front of the stipe becomes nearly flat and the back more convex, as in Fig. 1 *C*. Farther up all the sclerenchyma diminishes, and at the height of a few inches entirely disappears. The bundles, however, retain the same relative position and the pinnæ are given off right and left in the same manner as the branches of the stem.

In Fig. 1 *B* the bundle, *c*, divides and with part of the adjoining sclerenchyma enters the bud between *a* and *b* Fig. 1 *A*. In feeble plants this bud is suppressed and the branch at the left is reduced to a bud, so that the stipe then seems to arise directly from the main axis.—*A. A. Crozier, Ann Arbor, Mich.*

ATTEMPTED HYBRIDIZATION BETWEEN POND-SCUMS OF DIFFERENT GENERA.—In the latter part of May of this year, while examining a dish of material containing duckweeds (*Lemna polyrhiza*) and various fresh-water algæ collected in Southern Nebraska, I came across a case of attempted hybridization between two pond-scums (Zygnemaceæ) of different genera, which is well worth recording. The plants concerned were *Spirogyra majuscula* and *Mesocarpus scalaris*, both rather common pond-scums of our ponds and ditches. The normal mode of conjugation in this Spirogyra is by means of short lateral branches which unite so as

to form free passages between the conjugating cells, and through these the protoplasm passes from the one cell to the other, resulting in the formation of a resting spore (zygospore). In Mesocarpus the process differs in this that the protoplasm from both the conjugating cells passes into the connecting tube and there forms a resting spore. In the latter case the resting spore is thus inter-filar, while in the former it is intra-filar.

The two plants lay parallel to one another, finally crossing, as shown in the figure. Near the point of crossing each plant sent out a characteristic conjugating tube. The tube from the Spirogyra was bent up and partly around the filament of Mesocarpus, while the tube of the Mesocarpus had pushed out against the Spirogyra filament with such force as to indent the latter very greatly.

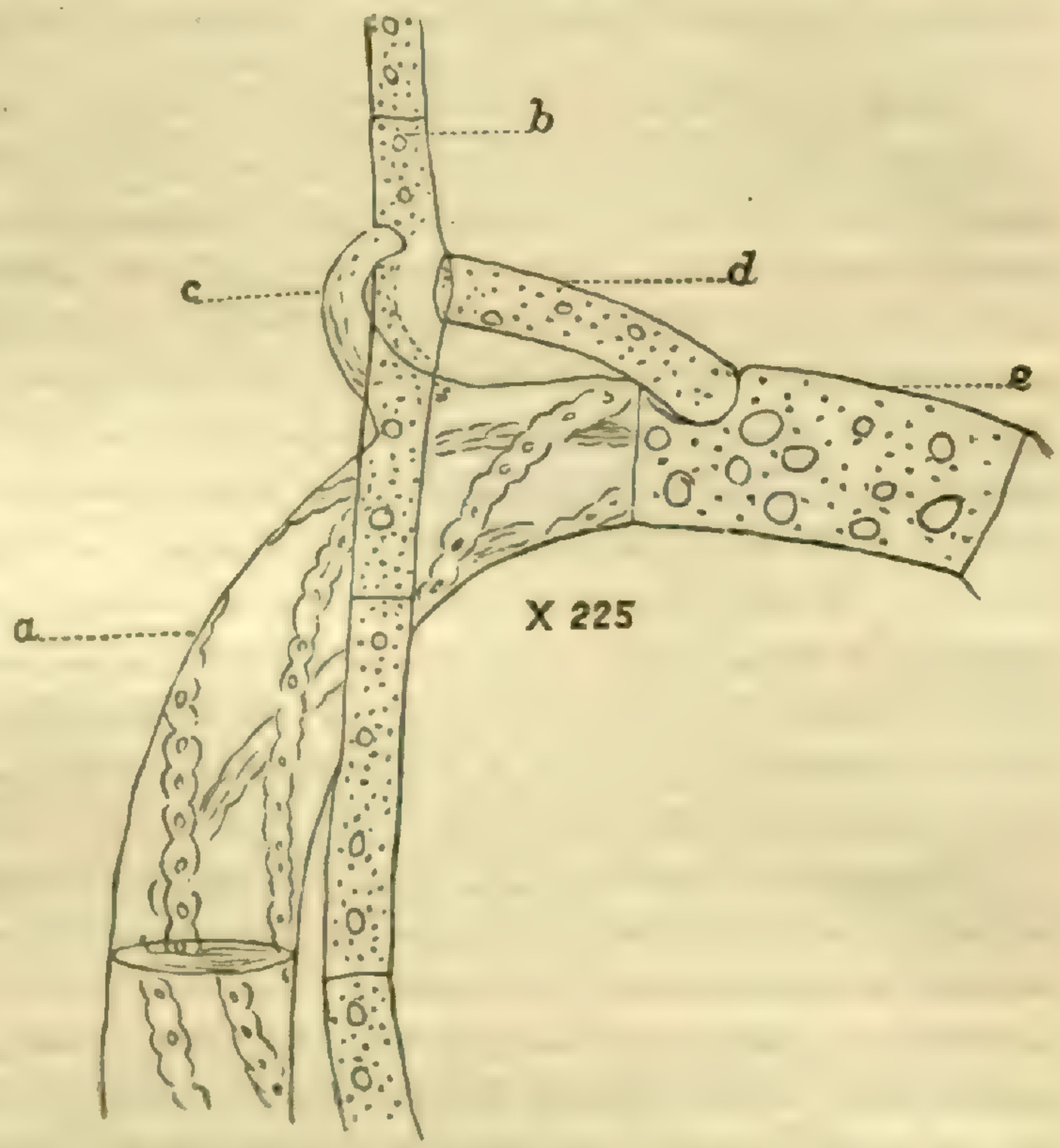


FIG. 1.—*a*, plant of *Spirogyra majuscula*; *b*, plant of *Mesocarpus scalaris*; *c*, conjugating tube sent out by Spirogyra; *d*, conjugating tube sent out by Mesocarpus; *e*, a dead cell of the Spirogyra plant containing parasites (Chytridium sp.).

The attempt at fertilization was futile, of course, and so no effort was made to keep the specimen alive. It was preserved in camphorated water and mounted upon a slide for further study and inspection.

We have in this case a suggestion of a reciprocal influence exerted by one cell upon another in the process of conjugation. It is probably a kind of sensibility to contact—an irritability, as the older vegetable physiologists would have called it. There was certainly a response to some influence on the part of one or other of these plants in the case before us. It is perhaps impossible to determine which plant took the initiative, whether the tube of Mesocarpus or of Spirogyra was first pushed out, but it is impossible to escape the conclusion that the second tube was pushed out in response to the first. It is possible that the first tube may have originally pushed out towards a filament of its own kind, and becoming displaced may have continued its growth towards the

stranger plant, exciting in it the production of a conjugating tube. I may say in conclusion that the position of the filaments and their appearance, under the microscope, precluded the supposition of an accidental juxtaposition.—*Charles E. Bessey.*

More Popular Botany.—A recently published little book, "Talks Afield," by Professor L. H. Bailey, adds another to the short list which this country as yet affords of readable scientific books on plants. We need not repeat here what we have said over and over again as to the duty of scientific men to prepare authoritative books which shall be written in non-technical language for the great non-scientific public. The author of the book mentioned has recognized this duty, and has given us a most readable as well as accurate volume. Twenty pages or so are given to a popular account of the greater groups of the vegetable kingdom, and then some of the most interesting features of flowering plants are taken up, as the flower, the stem, the rose family, the composite family, a peep at the inside, the sexes of plants, cross-fertilization, etc., etc.

We quote from pp. 74 and 75, as an example of our author's style: "The plant through its roots takes in various compounds which are dissolved in water. These compounds contain carbon, hydrogen, oxygen, nitrogen, sulphur, iron, potassium and other materials. The plant takes these solutions in through its roots by a modification of the phenomenon known to physicists as osmose, a sort of soaking-in process. The pressure exerted by the liquid as it comes into the root through this osmotic action forces the 'sap' upwards, but the chief cause of its rise is to be found in another fact: the stomata on the under surface of the leaves are open if the weather is clear and moist, and water is constantly evaporating from them. As fast as this evaporation takes place more water is needed. A demand is made upon the cells in the interior of the leaf which contain more water than those near the stomata, and as these interior cells lose some of their water they in turn call upon cells still more distant, and so on until the call is made all through the stem, and to the minute root-hairs which derive their water from the earth. This water does not flow upwards in tubes or cells, but it is soaked up through the thick walls of the wood-cells, and it keeps soaking upwards as fast as evaporation pumps it out through the leaves."

The publishers, Messrs. Houghton, Mifflin & Co., of Boston, have given the book a neat dress, and sell it for the reasonable price of one dollar.

The Botanical Club of the A. A. A. S.—There should be a good attendance of botanists at the meeting of the American Association for the Advancement of Science in Ann Arbor (August 26th to September 2d). Arrangements have already been made for excursions at low rates to the very interesting

Mackinac and Lake Superior regions. Botanists who are anxious to add to their collections can do so, and at the same time take a most enjoyable steamboat voyage upon the great lakes.

But let us ask here that the botanists do something to redeem the scientific reputation of their profession. It was a noticeable fact that for the greater part the papers presented by the botanists before Section F, last year, were characterized by far less depth than those which came from the other biological workers, the zoölogists. Is there a necessary reason for this in the nature of the two sciences, botany and zoölogy? Or is it a difference in men? May it not be due to a difference in habits of thought? Have not the botanists for so long thought of discovery as connected with new species that they have forgotten that there may be room for brilliant discovery in structural and physiological fields also?

Let our botanists prepare good thoughtful papers for Section F, and at the same time lay by numerous notelets for the Botanical Club, which will have frequent meetings during the association week. The club is intended to take in the shorter notes and lighter discussions which cannot properly find place in the section meetings.

Botanical News. — Centuries XIV and XV of Ellis' North American Fungi made their appearance a couple of months ago. The first is composed of miscellaneous plants of general interest. Century XV is devoted to the parasitic fungi, and contains seventeen species of Peronospora, seven of Uromyces, thirty-two of Puccinia, seven of Entyloma, besides many Æcidia and other imperfect forms. This volume is one of the most interesting yet published.——M. C. Cooke's Præcursores ad Monographia Polypororum, begun in the March *Grevillea*, is continued in the June number, the list reaching the 411th species. It is the intention of the author "to publish, in a collected form, all the scattered descriptions of the species known."——The last number of the *Journal of Mycology* contains a monograph of our species of the genus Ramularia. Work of this kind is much needed, and the new journal is doing good service in undertaking it.——Dr. Geo. A. Rex contributes a valuable and interesting paper to the *Botanical Gazette* (June) upon the Collection and preservation of the Myxomycetes. It will repay every collector to give the paper a careful reading.——The Report on Forestry, Vol. IV, 1884, prepared by N. H. Egleston and published by the Department of Agriculture, is exceedingly disappointing. The contrast between this volume and that of about the same size, lately issued by Professor Sargent, on "The Woods of the United States," is characteristic. It seems to be very difficult to get first-class work done in some of the government departments. Why cannot our officials learn that when they want a scientific problem investigated they must appoint *scientific* men to do the work.——

As an earnest of better methods we are glad to note the appointment of E. L. Scribner as assistant botanist to the Department of Agriculture. He has been assigned the care of the cryptogamic portion of the herbarium, and will devote most of his time to the study of the parasitic fungi, especially those which affect injuriously the field and garden crops.—— The April number of *Nuovo Giornale Botanico Italiano* contains an exhaustive paper, by Danielli, upon the structure of *Agave americana.* It is illustrated by seven large plates containing eighty-one figures.

ENTOMOLOGY.

THE BLACK, WHEAT-STALK ISOSOMA (ISOSOMA NIGRUM, n. sp.)— Early last autumn I received from Mr. Wm. Deyo, of Denton, Wayne county, Michigan, specimens of wheat straw which contained from five to sixteen larvæ of a four-winged (hymenopterous) fly. The portion attacked was usually near a joint, but might be anywhere along the internode, and was found above every joint, though very rarely above the highest one. The immediate region of attack was creased and deformed (Fig. 1), though not swollen, and was very hard, so that to cut it, except with a very sharp knife, was difficult. At this portion of the stalk, which was usually from three centimeters (one and a-fifth inch) to five centimeters (two inches) long, the straw was not hollow but solid throughout. By cutting into this deformed straw the yellowish-white larvæ were found in oval cells. These cells were about four millimeters (.16 of an inch) long. I published an account of this fact in several papers of Michigan and other States (see *Country Gentleman*, Vol. 49, p. 817) asking for further information. In response to these inquiries I received several communications from Wayne and Washtenaw counties, Michigan, in both of which the insect worked extensively.

FIG. 1.—Black dots show exit of fly.

So far as I can learn the insect has never been noticed before; and as the hardened pieces of straw break off in thrashing and come out of the machine with the grain, their presence could hardly escape attention. Mr. I. S. Vandervort, of Ypsilanti, Michigan, to whom I am indebted for many specimens, says the attack was quite general in Washtenaw county, and that the short straws in the grain had been noticed and commented upon by many farmers who had not even mistrusted that insects had anything to do with it. At our Farmers' Institute held at Plymouth, in January, I found hardly a farmer who had not been vexed by the small pieces of straw, yet not one had discovered the cause.

In the *Country Gentleman*, Vol. 49, p. 857, Professor J. A. Lintner refers to similar attacks of wheat in New York, and says the cause is the same species that has done so much damage in

Illinois and south—*Isosoma tritici*; yet from the brief description I think it far more likely that *Isosoma nigrum* is the insect which is doing the damage in New York. The farmers in Wayne and Washtenaw counties are not sure that the damage was very great, but all reported the wheat yield below their expectations. Professor Lintner estimated the loss in New York to be from sixty to seventy-five per cent in such stalks as were attacked.

Isosoma nigrum n. sp.—Female (Fig. 2): Length of body 4.4^{mm}; expanse of wing 6.5^{mm}; greatest width of anterior wing 1.1^{mm}; antennæ sub-clavate, somewhat pilose, reach to middle of thorax. The scape is a little less hairy, and as long as the two following joints together. The fourth, fifth, sixth and seventh joints sub-equal. Ten of the eleven joints are plainly marked when viewed with a hand-glass. Head and thorax black, dull, punctate, rugose and covered, though not densely, with fine gray hairs. Abdomen shining black, polished sparsely hairy; as long as head

FIG. 2.—Female *Isosoma nigrum* n. sp. Magnified ten diam.)

and thorax together and larger than thorax. The antennæ, including scape, mouth-parts, head, abdomen and thorax, except a small, rounded, light-colored spot on the pronotum just back of the eyes, are pitchy black. The trochanters, femora, middle and posterior tibiæ black. The anterior tibiæ, tibio-femoral joints, one-third of distal end of anterior femora, and tarsi are yellowish-brown. In some cases the distal ends of the tarsi are dusky. The legs are thickly pilose. The wing-veins are honey-yellow and extend to outer third of wing. Sub-marginal vein three times as long as marginal; marginal nearly twice as long as post-marginal; post-marginal and stigmal sub-equal. Described from more than 100 specimens. Wings in all perfect. Variations very slight.

The eggs (Fig. 3) are white, 75 to 100 in number; 1^{mm} long, and each with a

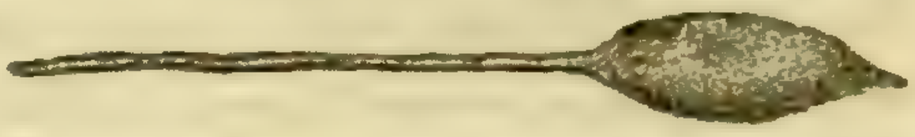


FIG. 3.—The egg.

pedicel two and one-half times as long as the egg.

Male; Length of body 3^{mm}; expands 5.8^{mm}; greatest width of front wing 1.3^{mm}; antennæ sub-cylindrical, longer than in the female, with more and longer hairs; the last seven joints sub-equal. Thorax and abdomen as in the female, except that the pronotal spot is wanting or very obscure; the abdomen slightly peduncled, shorter and hardly larger than the thorax. Coloration of body and appendages same as in female. Venation similar to that of female. The wings in both sexes are margined with hairs, which are rather coarse along the marginal and post-mar-

ginal veins. The general surface of the wings show numerous short hairs. The males are nearly as numerous as the females, and all have perfect wings.

Larva: The larva (Fig. 4) is yellowish-white; length 4^{mm}: jaws dark, without teeth. The antennæ are short, one-jointed tubercles of the same color as the body. Very few hairs. Stigmata very obscure.

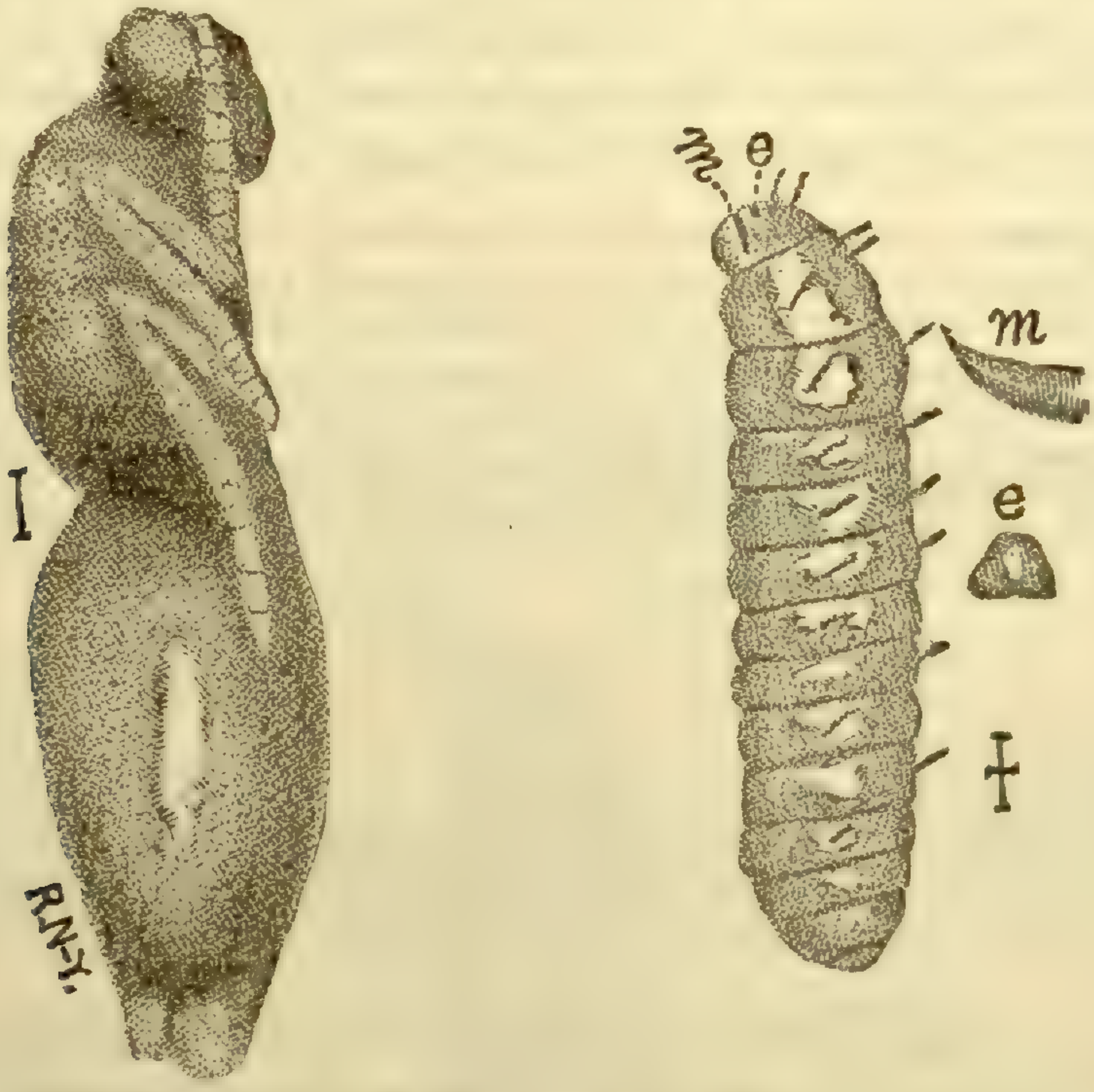


FIG. 4.—Larva and pupa. *m*, mandible; *e*, antennæ.

Pupa (Fig. 4): In autumn and winter white; in late spring black. Length 4.1^{mm}; male 3.2^{mm}. In autumn the wing pads are very indistinct, hardly visible, but in spring they are plainly marked.

This insect is very different from the *I. tritici* (Riley), (first described in the *Rural New-Yorker* of March 4, 1882), in being much larger, in its black scape in antennæ, black mesoscutum, black coxæ, light instead of yellow pronotal spot, the numerous males and the fact that all are winged. These work to the number of from five to fifteen at one place in wheat stems, instead of one or two, and the stalk solidifies. The larva has no teeth on its mandibles and only one joint to the tubercle-like antennæ. It differs from *I. grande* (Riley) but little in size; but in other respects the points of difference are much as above.

From the old joint-worm of Fitch (*I. hordei* Harris) it differs in being larger, in having a black scape to antenna, black mouth-parts, and in working in great numbers in a single straw, in causing the straw to solidify, in not forming a swelling and in working anywhere on the internodes of the straw.

From *I. elymi* (French) it differs in being much larger, and the legs are not so fully fuscous. *I. elymi* works in grass, which is probably true also of this species, yet they must be quite distinct, as shown by sizes.

Dr. C. V. Riley kindly informs me that he thinks this is *I. hordei*. He says he has specimens from Virginia, right where

the original types were found, some of which have a yellow scape, others a black one. He thinks this is Fitch's variety *tritici*. I at first thought this *hordei*, but the fact that Fitch makes no mention of any specimens with other than a yellow scape and yellow mouth-parts, and inasmuch as Dr. Harris and the late B. D. Walsh, with Fitch's descriptions before them, say all of Fitch's varieties are exactly alike except in coloration of legs, added to the fact that of the hundreds of specimens examined by me, not one showed any tendency to vary from black in scape and mouth-parts, while there was considerable variation in the coloràtion of the legs, led me to believe that my specimens were of a distinct species.

The fact, as Dr. Riley writes me, that so accurate a scientist as Dr. Harris does not speak of the yellow scape and mouth-parts would indicate that *nigrum* and *hordei* were identical.

Another entomologist, who has made quite an extensive study of these Isosoma, writes me that he inclines to the opinion that all our Isosoma are only varieties of one species modified by surrounding conditions.

It will take much observation to clear all this up. As species are only venerable varieties, which by age have been run into the mold of invariability, it really makes no great difference. Practically the matter remains the same in either case.

From what we know of related species, and from the fact that all the internodes (spaces between the joints) are attacked, or receive eggs, it is quite certain that the eggs are laid late in May and in June. By September the larvæ are matured. I found several pupæ in the cells of the straw on September 16. I found a few larvæ in January. It would seem, then, that a few of the insects pass the winter in the larval state. Specimens kept in a warm room all winter commenced to leave the cells in the wheat stalks, as mature insects, on March 22. At that date a male and female appeared. Each succeeding day ever since from two to eight have appeared. From straw kept in a cold room during the winter no flies have appeared until April 20. It is likely that in the common out-door temperature they would not come forth from the pupa state till May. This point can be easily settled in the field the coming season. This and the date and method of laying will have to await determination till the insects can be studied in the field the coming May. The method of oviposition is undoubtedly much like that of *I. grande* and *I. tritici*, as described by Mr. F. M. Webster (see Report Department of Agriculture, 1884, page 383), and Dr. C. V. Riley in the same volume, page 358.

If we may judge from the related insects, *Isosoma hordei* (see Fitch, 7th report, p. 162) or *Isosoma tritici* (see Forbes, 13th report, State Entomological Illinois, p. 30, and Riley, Report United States Department of Agriculture, 1881–2, p. 183) we

may be quite certain that the damage from this insect may become formidable. If, as I think, the insects referred to by Professor Lintner are of this species, then we have positive evidence that they lessen the yield of wheat very materially. Indeed, we can hardly believe that so many larvæ can draw from the juices of the stalk without doing it serious injury. The hardening of the stalk can but retard circulation of sap, and must interfere decidedly with the growth and development of the berry. Several farmers have told me that from appearances the yield of grain in their fields should have been much larger. They could not account for the diminished yield except by the presence of this insect, which was very common, as seen in the numerous hardened pieces of straw which came from the machine. It is therefore greatly to be feared that this new pest will become a serious enemy to successful wheat raising, especially as from a large number I have reared but a single parasite, which as yet is undetermined. Even if it becomes very destructive, it is more than probable that parasites will soon attack it, and that, like the joint-worm (*Isosoma hordei*), it will after a time become powerless to work very serious mischief.

The remedies for this evil are very apparent. As the insects are in the straw from the date of cutting till the following May, it becomes very apparent that by cutting the wheat high, in which case nearly all the insects will remain in the stubble, and then burning the latter, all these will be destroyed. In case there is much green vegetation, it would be better to cut the stubble low before burning. If short pieces of the straw are found in the grain, these should be cleaned out and burned. From experiments made in the laboratory, by burying the straws in sand, and the insects still coming out, I doubt if plowing under will prove a very thorough remedy. As these have good fully-developed wings, rotation of crops would not serve as well to protect against this insect as it would in case of *I. tritici* and *I. grande*.

The drawings were made from life by my special student in entomology, C. P. Gillett.—*Prof. A. J. Cook, Agricultural Coll., Lansing, Mich.*

Entomological News.—The Rev. J. A. Marshall publishes in the Transactions of the Entomological Society of London, issued April 30, Part 1 (280 pages) of a detailed monograph of British Braconidæ. The generic and specific characters are given in full, and there are six excellent colored plates. It will prove very useful for reference in this country.——Part III of Rev. A. E. Eaton's elaborate monograph of recent Ephemeridæ is at hand, and is accompanied by Plates 46–63, containing figures of very great interest, particularly Pl. 52, representing the nymph sloügh of *Bætisca obesa*, the aberrant and curious American form.——Bulletin 5 of the Bureau of Entomology, U. S. Department of

Agriculture, consist of descriptions of North American Chalcididæ from the collections of the U. S. Department of Agriculture and of Dr. C. V. Riley, with biological notes, together with a list of the described North American species of the family, by L. O. Howard. This paper will be followed by others, and will prove of great service to entomologists.——It appears from the observations of C. Aurivillius, reported in the *Entomologists' Monthly Magazine* for May, that *Œneis bore*, an arctic butterfly, requires two or more summers to complete its transformations; also that humble bees probably require more than one summer to mature.——At the meeting of the Entomological Society of London, held April 1st, Mr. R. M. Christy exhibited a drawing of the larvæ of the local form of *Platysamia columbia*, known as Nokomis; he had found the larva in Canada feeding on *Elæagnus argentea*, the peculiar silvery appearance of which was strikingly in accord with the color of the larva, which latter was probably protected thereby.——At a sale of beetles in London a pair of *Goliathus giganteus* realized £10 10s. 6d., and a pair of *G. albosignatus* £7 10s.; a pair of *Rhætus westwoodii* sold for £8, and a pair of *Rhætulus crenatus* sold for £2 10s.

ZOOLOGY.

Sense of Color and of Brightness in Animals.—J. Graber has investigated the sense of color and of illumination in animals. To decide whether animals had a sense of light or of color he placed them in a box so arranged that qualitative and quantitative rays fell on one or other of its two divisions, which communicated with one another. Five mammals, seven birds, two reptiles, three amphibians, two fishes, three mollusca, twenty-seven insects, two spiders, and two worms were experimented with. It was found that the sense of color as well as the power of perceiving light was much more widely distributed among animals than has been generally supposed. The variations in the sense of color in various animals are very great, but a much greater number of observations must be made before a definite solution of the problem can be obtained.—*Journal of the Royal Microscopical Society, February, 1885.*

Artificial Division of Infusoria.—Mr. Crisp at a late meeting of the Royal Microscopical Society called attention to some very interesting experiments by Dr. Nussbaum and Dr. Gruber on the artificial division of Infusoria. Dr. Nussbaum divided an Oxytricha into two halves, either longitudinally or transversely, and found the edges at the point of division were soon surrounded with new cilia. Notwithstanding that sometimes some of the body substance, or even a nucleus, was lost during the operation, the two halves became normal animals, with four nuclei and the characteristic ciliary apparatus. The head portion formed a new

hinder part, and the right half a new leg, The complete organisms thus formed again developed by spontaneous division. Simultaneously with Herr Nussbaum's experiments Dr. A. Gruber artificially divided *Stentor cœruleus* with the same results. If the divided parts of a Stentor were not completely separated they almost tore themselves apart, sometimes by rotating in opposite directions. If the cut was not very deep, monstrous forms might be produced, as, for instance, with two complete anterior or two posterior portions.—*English Mechanic.*

Organisms in Ice.—Professor Leidy relates that he had placed in his hands for examination, a vial of water obtained from melting ice which is used for cooling drinking water. From time to time, among some sediment taken from a water-cooler, his informant had observed what he supposed to be living worms, which he suspected were introduced with the water into the cooler, and not with the ice. Upon melting some of the ice alone, the worms were still observed, and the water submitted for examination was some that was thus obtained. Professor Leidy was surprised to find a number of worms among some flocculent sediment, mainly consisting of vegetal hairs and other débris. Besides the worms, there were also immature Anguillulæ, and a number of *Rotifer vulgaris*, all living. It would appear that these animals had all been contained in the ice, and had been liberated on melting. It was an unexpected source of contamination of drinking-water, that Professor Leidy had previously supposed to be improbable.

The worms were probably an undescribed species of Lumbriculus. Several dead worms swarmed in the interior with large, ovate, beaked, ciliated infusorians, measuring from 0.05 to 0.06^{mm} long by 0.04 to 0.48^{mm} broad.—*Journal of the Royal Microscopical Society, February, 1885.*

A Fresh-water Sponge from Mexico.—

Myenia mexicana, n. sp.—Sponge (as seen from an alcoholic preparation) green, minute, encrusting Lemna and other water plants.

Gemmulæ spherical, surrounded by a close series of berotulate spicules, embedded in a granular crust.

Skeleton spicules long slender, gradually pointed, smooth or very minutely microspined.

Dermal spicules wanting.

Berotulate spicules pertaining to the gemmules in length about three times the diameter of the rotules; shafts nearly cylindrical, sometimes more slender near the middle; irregularly spined; spines long acute. Rotules flat, deeply notched, rays irregular, acute.

This species, collected by Professor E. D. Cope in Lake Xochimilco, about seventeen miles south of the City of Mexico, differs from the familiar *M. fluviatilis* chiefly in the far greater length of the shafts of the berotulate spicules. It is further interesting as being only the second species of fresh-water sponge to reach the hands of specialists from that region of N. America. These particular specimens were probably collected in an immature condi-

tion, as suggested by the abundance of sarcode and the scarcity of gemmulæ or statoblasts; the single small group of these organisms alone rewarding a careful search through the whole mass of material sufficed to fix its generic position.—*Edward Potts.*

A Hermaphroditic Crab.—While conducting an exercise in zoölogy a short time ago using the common crab (*Callinectes hastatus*) I noticed one specimen having an abdomen intermediate in form between that of the normal male and female specimens. I at once inferred that it might be a case of hermaphroditism, which I think it is. The abdomen is triangular and except the terminal portion or telson is devoid of joints; the joints of the normal female abdomen being represented by indistinct lines. The abdomen was firmly imbedded in the plastron, it being evidently not within the animal's power to "open" it. The abdominal appendages resemble in general those of the female, although much more attenuated and having an undeveloped appearance. The fifth pair of pereiopods lack the reproductive orifice in the basal joint found in the male; nor is the first pair of pleopods modified into copulating organs. The two little hooks fastening the abdomen into its groove are present; while there are only impressions representing the opening through the female plastrons for the expulsion of the eggs. When examined the internal organs were not in condition for a minute examination, still it is evident that neither male nor female organs were normally developed, as these organs were distinct in other specimens in similar condition, while they could not be found in this one.—*A. L. Ewing, New York, June 29, 1885.*

Discovery of Blind Fishes in California.—At Santa Clara College in the San José valley is a flowing artesian well 170 feet deep, from which are discharged sightless fishes, from one to two inches long. I shall make arrangements to send specimens of these to Professor Baird, United States Fish Commissioner, who informs me that he has eighteen varieties or species of blind fishes from Eastern artesian wells; none have been secured from this coast.—*F. D. Caton.*

The Mule Deer in Domestication.—I find here three specimens of *Cervus macrotis* var. *californicus* in domestication, which have given me an opportunity of observing them not hitherto enjoyed. This variety of the mule deer I first discovered at Santa Barbara in 1875 and spent nearly a week in the mountains and procured specimens for mounting, which I sent to the Smithsonian Institution, and I first described them in The Antelope and Deer of America, p. 95. While they are a true Macrotis, the variety is very distinct, the enormous ear which induced Lewis and Clark, who first discovered them, to call them the mule deer is common to both varieties, but the ear on this new variety I now find is not

so uniform in size as in the Eastern or mountain variety. Of the three specimens now under observation, one, a male, one year old, has the largest and coarsest ear I ever saw on one of the species of that age, being eight inches in length; while the pair in the adjoining paddock, belonging to Mr. Palmer, are two years old, have ears seven inches in length, which are smaller than the average of the species, though still larger than those of *Cervus columbianus*, which has the next largest ear for the size of the animal of any of the American deer. In color, too, they are more variable than the mountain variety. The yearling specimen above described, belonging to Mr. Simmons, is of the dark gray color, so uniform in the mountain variety, from which no one would think of distinguishing it, but for the peculiar coloring of the tail, which is after all the most distinguishing feature of this variety from the other, and in these specimens is more pronounced than on the specimens procured at Santa Barbara.

In the mountain variety the entire tail is a yellowish white, except a jet black tuft at the end, while on the California variety there is a dark line extending on the top or upper side all of the way down to the terminal black tuft. In the Santa Barbara specimens this dark line down the tail was of the color of the coat above, while on these the dark line is black like the terminal tuft—at least this is the case with the yearling buck and the two year old doe, which are evidently of normal color. The two-year-old buck, however, is of a much brighter color than any other Macrotis, which I have seen. While it is not a white deer it approaches the white, the ears being the darkest, or nearest the normal color of any part of the animal. On the tail of this deer the dark line is much obliterated, but not entirely so.

That which distinguishes *C. macrotis* from all other deer is that the under side of the tail is naked to about the same extent as the horse's tail. This peculiar feature is observed on all of the specimens of both varieties to the same extent.

The habitat of *C. macrotis* is from the Missouri river to the Pacific ocean and from British Columbia to Mexico. So far as I have present information, this California variety occupies a region south of San Francisco and not extending east of the State line. I lack evidence to show that it is not confined to still narrower limits.—*J. D. Caton.*

The Greek and the Modern Foot.—It is well known that the Greeks represent the second toe as longer than the great toe in their statues, while in the modern European foot, the great toe is generally the longer. In this respect, as stated by Albrecht, the Greek foot is more quadrumanous than the modern. The antique statues generally represent the great toe as standing further from the second than is seen in the moderns. This might also be a quadrumanous character according to Schaffhausen, but Albrecht

thinks it is only the result of the wearing of the sandal strap. The reduction of the smaller toe Albrecht is disposed to ascribe to the wearing of shoes.

ZOOLOGICAL NEWS.—*Cœlenterates.*—Mr. S. J. Hickson (Trans. of the Roy. Soc., 1883) describes the ciliated groove which exists upon the ventral side of the stomodæum in many of the Alcyonarians. This groove, or "siphonoglyphe," which keeps up the circulation of water whilst the animals are retracted, is not present in the three genera of simple Alcyonaria, assumes more important proportions in these colonial forms (as Alcyonium, Spongodes, etc.), which have long body-cavities, is present in one of the two forms (the siphonozoöids) of the dimorphic Alcyonaria (Pennatulidæ), and is absent in the Gorgonidæ, in which the solid axis occupies a greater bulk than the sarcosoma. The author works these facts into a new classification of the order, which he divides into (1) the Proto-alcyonaria, (2) the Stolonifera (Tubipora, Clavularia, Sarcodictyon, etc., (3) the Pennatulida, (4) the Gorgonidæ, containing the Primnoaceæ, Gorgonaceæ, and other families without a siphonoglyph, (5) the remaining Alcyonarians (Cœlogorgia, Paragorgia, etc., with a siphonoglyph.

Echinoderms. — In the Philosophical Transactions of the Royal Society (1884), Mr. Herbert Carpenter describes a new crinoid from the Southern sea. This species, *Thaumatocrinus renovatus*, presents two characters found in no other Neocrinoid, but present in some of the older Palæocrinoids. These are the persistence of the oral plates of the larva in the adult, and the separation of the radials by interradial plates. There is also a closed ring of basals on the exterior of the calyx, and a jointed arm-like appendage on the interradial of the anal side. The example was dredged at a depth of 1800 fathoms. Like Eudiocrinus, it has but five arms, and is very small.

Crustacea.—Recent notes upon crustacea, by E. J. Miers, published in the Proc. Zoöl. Soc., London, include a list of thirteen decapods from the Mauritius, five of them not before recorded, from that island, and one, *Callianassa martensii* Myer, believed to be new to science.

Mr. F. Day (Proc. Zoöl. Soc., 1884) exhibited the skin and skeleton of a female *Acanthias vulgaris*, the whole of the flesh of which had been eaten out by the Isopod, *Conilera cylindracea.* About twenty examples of this crustacean, some of them one and a quarter inches long, were taken from the remains. Mr. Dunn, of Megavissey, who sent the specimen, remarked that in the summer months these lice are very abundant fifteen to twenty miles from land, generally on soft and sandy bottoms. He had taken one hundred dog-fish at once in a mullet-net, but nearly every one was found to have been eaten in a like manner. They devour a fish in a few hours, and hunt in large shoals. Congers and other

fish leave when they appear, but occasionally a shoal of bream will come and eat them up.

Fishes.—In the Proceedings of the National Museum Professor Jordan published a paper which includes notes by Mr. S. B. Meek on the types of North American freshwater fishes, found in the museum of the Philadelphia Academy. The latter display some deficiency of due caution, to say nothing of amenity, in dealing with the subject. Confidence in some positive identifications, and also some discoveries of error, will be much weakened by a knowledge of the fact that some of the specimens bear unreliable labels. These were placed upon them by a person employed for the purpose by the "authorities" of the Academy, who was totally ignorant of ichthyology, and not very well acquainted with the English or classical languages. At the time of the taking charge of the collection by this person, many of the specimens had not been distributed into separate bottles, and numerous labels were contained in each bottle. Of course they could not be attached to the correct specimens by the curator in question. Mr. Meek finds that the characters of one of the species were derived from "the shrivelled condition" of the type specimen. It is difficult to imagine where Mr. Meek obtained this information, as the specimen was in a perfectly fresh state when described several years before Mr. Meek was known as a student of the subject.

Batrachians.—Mr. G. A. Boulenger (Proc. Zoöl. Soc., 1884) describes eight new species of Batrachia from the Solomon islands, including the new genus Ceratobrachus.

The greater part of England is free from the croaking of the frog, but a croaking edible frog has for some time been found at several spots in Cambridgeshire and Norfolk. This form, usually thought to have been introduced from France and Belgium, has been shown by M^{r}. G. A. Boulenger to be the Italian form, *Rana esculenta lessonæ*. Forty years ago the typical *R. esculenta* was turned out in great numbers in Norfolk, and examples have recently been taken. Though, when the whole Palæarctic range is considered, it is difficult to keep these forms apart, so far as regards England they are quite distinct. Indeed, if the genus Pyxicephalus of many authors is admitted, the form *lessonæ* would fall into it. There is no authentic record of the introduction of the Italian variety, but it was possibly done by the monks.

Birds.—Capt. G. E. Shelley (Proc. Zoöl. Soc., 1884) describes three new species of birds from the Kilimanjaro district, East Africa. These are *Muscicapa johnstoni*, *Nectarinia kilimensis*, and *Pratincola axillaris*. *Nectarinia reichenowi* (*Drepanorhynchus reichenour* Fischer) is described and figured. The specimens came from heights of 5000 to 8000 feet.

Two examples of the American kestrel (*Falco sparverius*) are reported to have been seen in May, 1883, at Helmsley, in Northeast Yorkshire, England, and the female was shot.

A new Laniarius, *L. lagdeni*, from Ashantee, has been described by Mr. R. B. Sharpe.

Mammals.—An examination of the uterus of the four-horned antelope, made by W. F. R. Welden, showed that it is divided into two compartments by a partition extending one inch into a passage internal to the os uterus. The Fallopian tubes are very small. The placenta is exactly intermediate between the completely diffuse one of Moschus, and the complexly cotyledonary apparatus of the sheep, for example, on the other. Each fœtus has twenty-two to thirty cotyledons.

The lesser koodoo (*Strepsiceros imberbis*) differs from *S. kudu*, not only in its smaller size, but in the absence of the fringe of long hair down the neck in front, and in the much more compressed spiral of the curvature of the horns. Mr. Holmwood, British Consul at Zanzibar, states that it occurs on the Juba river, exactly under the equator, in groups of three or four. A stuffed example from Somali land is in the British Museum.

EMBRYOLOGY.[1]

On the availability of embryological characters in the classification of the Chordata.—The development of a median axial cord, differing essentially from cartilage, and which seems to arise from a strand of cells constricted off longitudinally from the upper side of the hypoblast and having the same or almost the same extension anteriorly and posteriorly as the nervous cord, at once distinguishes all embryo and primitive Chordata from all other types, and justifies the substitution of the latter term for the older name, Vertebrata. It is obvious that the term Chordata is a more applicable one for the reason that there are forms which never develop vertebræ, while there are none in this series which fail to develop a notochord at some stage, having the antero-posterior extension described above. The name Vertebrata, therefore, carries with it implications which are not justified by facts. Lankester insists for this reason that the term Vertebrata be abandoned, and that the word Chordata be substituted for the name of the phylum, so as to express a fundamental truth in scientific taxonomy.

It has been insisted that embryological data are not available for the purpose of discriminating classes, subclasses, etc., and, judging from the more or less unsatisfactory attempts made to arrange the Chordata on a purely embryological basis, this opinion has not been without foundation. The following notes are not so much intended to bring a new system to the notice of naturalists as to arrange some of the data of embryology in what seems to the writer a rational order. While it must be admitted that our knowledge is still imperfect in relation to the develop-

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

ment of certain considerable groups, every addition to that knowledge demonstrates that what has appeared to be exceptional or in violation of general principles, upon further investigation has really substantiated those principles. Inasmuch as the theory of evolution, as well as that of embryology, first considers the simplest phases of differentiation, the order in which the types should be successively considered will be an ascending one, in which we will pass from the least to the most differentiated modifications of the egg and embryo, without admitting, however, that the order of arrangement here adopted is indicative of the exact course which the evolution of the groups has taken. That is a problem which for obvious reasons no one will probably ever solve or succeed in stating with more than partial accuracy. The scheme which follows is therefore offered merely to show the arrangement which results when embryological characters alone are used, and will, the writer believes, serve at least to bring together the principal facts so as to display the direction along which specialization has progressed in the course of the evolution of the modes of development of the various chordated forms.

The Chordata present three well-marked modes of embryonic development consequent mainly upon the manner in which the germinal matter of the egg is related to the vitellus, and upon how much the latter takes part directly in the formation of the embryonic organs, and in what manner the blastula or blastophere is directly related to its environment in the course of its development and growth. The direct influence of conditions which induce modifications in a purely mechanical manner is very plainly illustrated in embryological development; in fact it may be shown that the highest type of development as displayed in the greatest complexity of the germ or embryo has grown out of a simpler condition developing under simpler environing conditions. It may thus be shown that *even the mode of development of the ovum has been modified through adaptation.*

I. The lowest and most unmodified expression of chordate development is that which I will call the Haplocyemate, as seen in the single type Branchiostoma. Here the embryonic axis develops directly from a double-walled gastrula formed by the invagination of one side of the blastula into the other half. The myotomes are developed from paired diverticula of the mesenteron, and the development is not modified in any way by the presence of a yolk-sack. This group embraces forms in which no part of the ectoblast is cast off when the embryo is set free, and in which there are no special respiratory saccular membranes developed in connection with any part of the blastula or blastodermic vesicle; no primitive streak.

Ovum with a zona radiata only, which becomes distended and tensely filled with water around the egg proper; no albuminous

envelope and no outer shell or additional membranous covering. Cleavage total and equal, as a result of which a blastula is directly developed. The invaginated half of the blastula leads directly to the formation of the intestine. No actinotrichia or embryonic fin-rays developed. These features seem to distinguish the Leptocardii, or Haplocyemate forms from the succeeding ones.

II. The second great subdivision of the Chordata I will call the Epicyemate subphylum. In this series the embryo never becomes bodily invaginated or so pushed into the blastodermic vesicle as to become invested by up-growing folds of the ectoblast, but remains attached to the yolk by a stalk or is sessile upon and external to the latter, which may or may not form an integral part of the intestine. This group also embraces forms in which no part of the ectoblast is cast off when the embryo is set free. There is no amnion nor any functional allantois developed. The vessels of the yolk-sack, when developed, are respiratory in function. The primitive streak is either comparatively short or wanting. This subdivision answers very nearly to the Ichthyopsida of authors.

1. The lowest division of the Epicyemate series may be called the Ichthyoidea, and brings the Amphibia and Marsipobranchii together. In them the ovum is provided with a zona radiata; there is no outer albuminous envelope; the zona is often elastic, and the cavity it encloses may increase with the progress of development, and may be covered externally with an adhesive or gelatinous investment. The cleavage is unequal; no true blastodisk is formed; the germinal and nutritive poles are, however, soon defined at opposite poles of the egg. Vitellus segmented into large spheres which enter into the formation of the inferior portion of the intestinal wall. Oviparous, or the ova are carried about by the parent in dermal pouches.

a. The first subseries of the Ichthyoidea is enterotrophous, that is, the yolk-cells in the embryo are in a ventral position, and extend along the whole of the middle and posterior part of the developing intestine. Amphibia.

b. The second subseries of the Ichthyoidea are opisthotrophous, that is to say, the yolk-cells while they enter into the formation of the ventral portion of the intestinal wall as in *a*, they are in a posterior position; the embryonic axis is formed from behind forwards, so as to appear as if it grew out from the posteriorly-placed mass of yolk-cells. Petromyzon.

Much may be said in favor of affiliating the marsipobranchs with the amphibians, but whether the development of Myxine will countenance the foregoing arrangement remains to be learned. It is, however, very certain that the general plan of development of the two preceding series approximates that of Branchiostoma far more closely than the more specialized development of the Ichthyes.

2. The highest major group in the Epicyemate subphylum I will call Ichthyes, as it is the only series in which true fin-rays are developed, and in all of the forms embraced by the term true embryonic fin-rays, or actinotrichia, may be found in the fin-folds of the embryo.

The ovum is provided with a zona radiata, but is entirely without or has only an inconsiderable albuminous envelope, rarely with loose granules of proteinaceous matter included between the vitellus and zona; no chalazæ; no calcareous shell, though sometimes there may be present in addition an outer tough, fibrous envelope (Elasmobranchs), or a canaliculated gelatinous (Perca), or a partially separate adhesive investment (Amiurus). The cleavage is partial, but a well-defined blastodisk is developed: the blastophere is formed by epiboly or growth over the vitellus. The vitelline matter is contained in the inferior pole of the blastophere, but never enters directly into the formation of a part of the intestinal wall.

a. The first subordinate group under Ichthyes is characterized by being ectotrophous, for the reason that the embryo is sessile for only a short time, as it soon becomes folded off from the yolk and raised upon a hollow umbilical stalk, so that the yolk eventually occupies an apparently extra-abdominal position, or rather it lies in a bulbous extension of the abdominal cavity. This series embraces the Selachians and Holocephali.

b. The second subdivision of the Ichthyes is equivalent to the Teleostomi of authors. These, as far as known, are cœlotrophous, that is to say, the embryo is sessile upon the yolk, and is never folded off so as to develop a stalk; the yolk is intra-abdominal and below the intestine and between the latter and the greatly distended somatopleure.

The Teleostei, Holostei and Chondrostei belong here, and it will be very surprising if any embryological characters are ever found which will separate the archaic Crossopterygians and Dipnoans from this series. For the characters of the latter we must, however, await the results of the researches of Mr. Caldwell.

III. The third subphylum of the Chordata is Endocyemate, that is, the embryo is more or less completely invaginated into the blastodermic vesicle at an early stage, in consequence apparently of its being confined in a contracted space, such as the uterine cavity or outer egg-membranes and shell, as a result of which are formed from the ectoblast, during the further growth of the embryo: (1) the amnion and its cavity, (2) the false amnion and its cavity; into the resulting space between these two membranes the allantois and umbilical vesicle are extended. The primitive streak is usually more or less prolonged behind the embryonic axis. This subphylum embraces forms in which a part only of the ectoblast enters permanently into the formation of the embryo, while a larger portion from which the false

amnion or the *Reichert'sche deckschicht*, Rauber, subzonal membrane, Turner, serous envelope, von Baer, and the true amnion, are formed, is cast off at birth or when incubation is completed. A highly vascular allantois is also developed in the majority of the species of this group, and, as a rule, takes the most important share in the respiratory functions of the embryo, and in the development of the fœtal part of the placenta whenever that organ is present.—*J. A. Ryder.* [*To be continued.*]

PHYSIOLOGY.[1]

PFLÜGER'S "AVALANCHE THEORY" OF NERVE-CONDUCTION.—M. Vulpian calls attention to the fact that in faradisation of various motor areas in the cerebral cortex of the dog, the effective strength of current which must be used varies definitely with the region stimulated. The minimal effective strength of current for the muscles of the face is less than that for the muscles of the fore-limb, and still less than for the muscles of the hind-limb. In general the strength of effective current must increase with the length of motor nerve tract. This result is readily explained if we consider that the nervous impulse started in the brain gradually diminishes in power as it passes along the motor nerve. But this assumption is in contradiction to the classic "avalanche theory" of Professor Pflüger, according to which the nerve impulse accumulates energy in its progress, so that a certain strength of stimulus applied to a motor nerve produces a stronger contraction the farther the place excited is removed from the muscle. It is this theory which Vulpian undertakes to test, and concludes with a denial of its adequacy.

In Vulpian's experiments dogs were used and so heavily chloralized as to paralyze the reflex powers of the spinal cord. He carefully isolated, without cutting, the external popliteal branch of the sciatic nerve and also the anterior tibial nerve. These nerves are in the dog of about the same thickness. Vulpian found that with a weak current strong flexion of the foot was brought about by stimulating the anterior crural, while no movement was produced when the popliteal branch was excited with the same current. He therefore concludes that the nervous impulse, far from gathering strength in its passage along a nerve, is used up in its progress and gradually diminishes in intensity.—*Comptes Rendus, Tome C, p. 1038.*

MOVEMENT OF THE RETINAL CONES UNDER THE INFLUENCE OF LIGHT.—But three kinds of physiological change have been observed in the retina as an effect of the action of light: 1. The electrical currents discovered by Holmgren; 2. The bleaching of the visual purple in the outer segments of the retinal rods; 3. The movement of the pigment in the outermost or epithelial

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

layer of the retina; both the latter phenomena were discovered by Boll. But Professor Engelmann, of Utrecht, adds another to the objective disturbances caused by light in the retina, namely, that of movement of the inner segment of the retinal cones. The inner segments of the cones become shorter under the influence of light and longer when the light is removed. The amount of this difference in length owing to illumination varies in different animals. The difference was most marked in the fish and frog. In a fish which was kept eight hours in the dark the inner cone segments, measuring from the *mem. lim. ext.* to the inner pole of the cone ellipsoid, had a length of about 50μ; after remaining several hours in diffuse daylight the length of the inner cone segments in the same animal was only about 5μ. In preparing the retina for observation the eye-ball was rapidly excised and plunged in 3.5 per cent nitric acid, or for several minutes was warmed to 70°–80° C. in 0.5 per cent salt solution.

A frog which has been kept in the dark shows maximal contraction of the cones after several minutes exposure to diffuse daylight. All parts of the visible spectrum produce the change in question, but the more refrangible rays have apparently most marked influence. It is apparently the inner cone segment itself which is directly affected by the stimulus. The movement of the cones and of the epithelial pigment seems to be under the control of the nervous system; for if an animal which has been kept long enough in the dark to bring about maximal lengthening of the cones and retreat of the pigment, be exposed to light so that only one eye is illuminated, the influence of the light is manifested by both retinas; but if the brain has been previously destroyed, the contraction of the cones and the moving inward of the pigment occur only in the eye which is directly exposed to light. We may, therefore, consider that the movements in question are reflex actions, and that the optic nerves contain *motor* fibers for the protoplasm of the cones and of the retinal epithelium. Engelmann declares also that light acting directly upon the skin of a frog whose head is kept in the dark, brings about the same retinal changes as does light falling directly upon the eyes.—*Pflüger's Archiv., Bd. 35, s. 498.*

PSYCHOLOGY.

Applied Metaphysics of Sex.—When ethics is reduced to a science it is a department of metaphysics. Its application to practice will be "morals." One of its data is the law of Confucius, that man should not do to another what he would not wish that another should do to himself. The converse of this proposition, as uttered by Christ, imposes a greater proportion of active measures. Both are relatively carried into practice to the degree in which the wishes of men are subordinated to their intelligence.

They embody the regulating principle for what are called the purely selfish or appetent qualities of the mind.

For the sympathetic qualities, whose selfishness is diffusive, and includes good will to one or more other persons, somewhat different data are necessary. The leading interest in this department is that of sex. The metaphysical condition of love, is a pleasurable hyperæsthesia connected with the mental or actual image of a person of the other sex. The province of ethics, and its application in law in this matter, is the security of the persons interested in this property, mental and physical. If this hyperæsthetic state were always prominent, because based on sufficient grounds, there would be no necessity for laws in the matter, any more than there is necessity for laws to compel people to retain a fortune or a sound stomach. But in fact this hyperæsthesia sometimes has no sufficient *raison d'être* in the character of its object. Sometimes the mental powers are unable to retain it long at a time; and some persons have little or no capacity for its metaphysical form. For the protection of people who are highly developed in this respect, laws have been enacted which punish infringements on their rights of property.

It is, however, evident that these laws may and do work to the injury of the people they are designed to protect. This is the case, *e. g.*, when persons of great affectional capacity are bound to those of little or no capacity. It is the case where a person of fine general organization is bound to a person of coarse and brutal organization. It is also true where persons of high development of sex affection are otherwise of totally diverse and antagonistic constitutions. Hence divorce laws for the separation of such ill-mated persons have been enacted, and their utility cannot be denied.

It is not divorce laws which are to be feared, but something which lies deeper; that is the weakening of the metaphysical sex interest, and its subordination to lower or less important interests. Any system of religion, state policy, or social custom, which tends to weaken the force and freedom of conjugal affection, is probably the greatest curse that can befall a country. A principal reason why this is true is because the metaphysical sex interest constitutes one of the most important stimuli to exertion, and therefore to development.

One of the causes which destroy this primal source of energy and happiness in life, is the prevalence of the idea that the sentiment of love has no real existence; that it is a deception, or at best a sensation of short duration. Such a view can only be demonstrated in the lives of people in whom the instinct and sentiment are weak or wanting. For such it is doubtless true; but the blind man cannot prove that all men are like himself; he is debarred by natural incapacity. But well-constituted persons frequently adopt the idea on various grounds. The reason why

such well-constituted persons may entertain such a view, is the failure of the individual to realize his or her ideal in this direction.

One principal cause of failure to realize the ideal conjugal state, is constitutional weakness of the sentiment. This may be mental alone, or it may be physical. If the "grand passion" is to exist, its physical basis must not be destroyed. When the affection is properly developed, it leads to a subordination of many things which would conflict with it. Truth and honor become the basis of permanent confidence between the contracting parties, and everything that is disagreeable to the object of affection will be abandoned, so far as consistent with the necessities of existence, and of honorable conduct to others. When the sex sentiment is not well developed, these ameliorations will not take place. One or both persons will have ground of complaint, and if in the balance of motives either finds it more pleasant to him or herself to be disagreeable to their matrimonial partner than to be agreeable, the term of such persons' association is likely to come to a speedy end. In the case of personal bearing the male sex is often the sinner, since the more sensitive nature of the woman requires more consideration than the more indifferent constitution of the man. In the matter of rationality of conduct and opinions, the female more frequently errs.

One of the causes which tend to weaken the sex sentiment, is want of intellectual sympathy. This is at present a more or less necessary evil, but the development of the intellect is progressing, and will bear rich fruit in the field of the affections. Perhaps the most important factor in this progress, is the education of women. Their general want of interest in and knowledge of the thoughts and interests of man, is a fruitful source of the indifference with which devotion is too often rewarded; and it is impossible that it should be otherwise. Women of feminine type, with developed intelligence, have never failed of response from the other sex.

The metaphysical history of love is one of development, like that of any other mental faculty. Women display a greater capacity in this respect than men, for while many of them are as incapable in love as in reason, they much oftener rise to a high development of affectional activity and power than does the otherwise stronger sex. As to the application to practical life, the principle to be kept in view is this: the highly developed must be protected from the badly developed, both in and out of matrimony. As development of the mind in any faculty is a slow process, for a long time law will have to divide its sanctions, so as to encourage fidelity on the one hand, and on the other to facilitate the separation of incongruous partners. And that is what it is now doing in some countries with generally good results. Where divorce laws are properly framed and executed, if any social evils exist, they are due to defects in people them-

selves, and cannot be overcome by enactment. But in many countries the laws are such as to encourage and increase social evils, if not to produce them.

It is satisfactory to know that nature is necessarily more conservative in this field than in any other, so that pessimism has little ground for assurance. The incapable and the feeble in love have little part in the increase of the race. The irregular, excessive, or abnormal development of the passions have still less chance of propagation. The only cause for regret is the apparent inability of the best intellect to reproduce itself in any abundance. The future of applied science may bring us the remedy for this also.—*E. D. Cope.*

Tenacity and Ferocity in the Raccoon.—Happening lately to pass around the shores of a neighboring pond in my rambles, I noticed a crowd of boys gazing excitedly at one of their companions who had mounted a large tree overhanging the water, and was "shinning" his way toward the top of it. Inquiry revealed the cause to be a half-grown raccoon, which had taken up its quarters there for the day, seeming much disposed to stay where it was, despite the efforts of the youth to dislodge it; and he, having exhausted every method of persuasion suggested by his fellows, reluctantly descended to the ground, and a bombardment of stones then began which, though often well directed, did not budge young Procyon one inch from his comfortable position.

One of the spectators then produced a revolver and two rounds were fired by the "best shots" in the crowd, six bullets of the fourteen taking effect in its body. Terrible as these wounds were afterward found to be, the animal "held the fort" (so to speak) with dogged tenacity, its only efforts being confined to clinging to its chosen position in a fork of the tree. Seeing this, one of the boys started off and in a few minutes returned armed with a rifle. The second shot from this struck one of its fore-feet, passing directly through the ball of it. This wound, trivial when compared with the others, so maddened the poor beast that it tried hard to change its position, but its hindquarters being paralyzed it was unable to accomplish that feat, so in sheer desperation it began to rend the useless member with its teeth, savagely tearing it to pieces and dropping them to the ground. Another sure-flying bullet now sped on its merciful errand, and, struggling fiercely with death, the raccoon relaxed its grasp till one paralyzed foot alone sufficed to support its swinging body beyond the eager reach of its tormentors. And there it hung on, till in its dying efforts to regain the former position, it fell fifty feet to the ground with enough life remaining to justify considerable commotion among the boys while administering the *coup-de-grace.*

This instance brings to mind another which happened during the winter of 1879–80. Whilst a scholar at Westtown, Chester

county, Pa., I found, during one of my excursions along Chester creek, a half-grown "coon," which had snugly tucked itself up in the forks of a dead willow that stood on the opposite bank of the stream from me. It had its back to me, and desirous not to spoil the valuable pelt, I drew off some twenty yards and sent a heavy charge of shot into its body;—such at least was my intent, but, judging of results, I did not accomplish it. Beyond a violent tw tching of the skin as if to rid itself of a fly or other insect pest, there was no counter demonstration on the coon's part. My next fusilade was tendered from the creek bank, the long barrel of my weapon reaching within fifteen feet of the animal. At touch of trigger the results were tremendous, and after taking sufficient time to recover lost ground and senses, I realized that the concussion had worked both ways, and the coon, thoroughly aroused from its day-dream, was now floundering about, growling and gurgling in the depths of the creek. Having spent nearly a minute in that manner, it rose to the surface and divided its efforts there between reaching the bank and tearing the wounds in its body with teeth and claws, evincing a most desperate fury in every action. After continuing this long enough to have drowned the liveliest of cats, it reached the opposite shore, and instead of climbing upon it, the maddened creature disappeared *beneath* it, where a strong eddy of the waters washed and swirled under the overhanging banks and tree-roots. This suicidal manœuvre seemed so deliberate and intentional that hope of securing my game was well nigh gone from me ere it again emerged growling and gnashing its teeth as if enraged that it had not found death by other hands than mine.

Becoming fully sated with such an exhibition of brute ferocity and self-inflicted sufferings, I crossed the creek and succeeded, after a ten minutes' skirmish, in reducing it to perfect harmlessness without other disaster than several desperate nips on the toes of my boots, one of which was received after I had supposed the animal was dead.

I refrain from entering into detail of this closing scene further than to remark that it so impressed me with the fiendish vitality of a wounded raccoon, that hereafter similar encounters will be carefully avoided.—*S. N. Rhoads, Haddonfield, N. J.*

Likes and Dislikes of a Deer.—Mr. Simmons, who owns the yearling deer which I have mentioned in my article on Macrotis, informs me that he allows the barnyard fowls to share the grain fed to him without the least manifestation of hostility or displeasure, except as to a cock belonging to a neighbor. Whenever this bird flies into the paddock to pay a neighborly visit, the deer "goes for" him at once and puts him out with manifestations of anger or repugnance.—*J. D. Caton.*

ANTHROPOLOGY.[1]

BURNT CLAY IN THE MOUNDS.—The earliest travelers among the Indians mention mounds with buildings on the top of them covered with earth. In the mounds which I have examined, wherever burnt clay has been found more or less ashes occur underneath, and the impress of grass, sticks, cane or poles plainly reveals itself in the burnt clay. These vegetable substances were needed to support the earthen roof of the dwelling.

The dwellings of some modern Indians are built of poles, sticks and grass, covered thickly with mud. Upon the death of any of the inmates the house is burned down, and the framework consuming partly bakes the clay and leaves its impress therein. The Pimos and Maricopas of the Gila river, with all of the Indians of the Colorado river, build winter and summer dwellings. The former are hemispherical and mud-covered, the latter is an open mud-covered shed. When these are burned down at death, the clay is baked and appears just like that dug from many mounds.

In many of the modern houses the earth is dug out in the center for a foot or more; this points to the reason for the pits found in the middle of mounds. Charred posts are found in mounds, the same phenomenon presents itself whenever a summer shed is consumed.

In examining the celebrated ruins of adobe and stone houses in Arizona, it is found that they were destroyed by fire, burnt clay with impressions of sticks and poles being found in them.

The examination of some mounds demonstrates the existence of buildings without clay covering. Now I have lately visited several Indian tribes who live in the hot season under sheds covered with thatch, with merely earth enough above to keep the twigs from blowing away. Now the burning down of such a shelter would leave only ashes and charcoal.

Again, both houses are on the outside the receptacle of everything which the Indians wish to keep out of harm's way, baskets, pottery, wattled granaries for corn, mezquit, &c. Now in some mounds I have found the pottery and other relics so curiously located as to leave little doubt in my mind of the burning of such a structure as I have just described.

The modern hut builder does not cover his consumed dwelling with a mound because the new arts taught by the white man and his new environment have taken away all necessity. Furthermore the argument that the superior arts of the former Indians were associated with better houses for the artists is false. The finest works of modern art are produced in places no more elegant than the Pimo's summer shed.—*Edward Palmer*.

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

MORTALITY IN WASHINGTON.—Dr. B. G. Poole, of the Health office in Washington, has compiled a table of mortality by months, from 1875 to 1885, eleven years. This table not only exhibits the death rate of the months, but shows the disparity between the whites and the negroids. In comparing the results it should be borne in mind that the white population is about double that of the negroids:

	White.	*Negroids.*
January	192	163
February	177	180
March	207	184
April	178	170
May	166	157
June	212	206
July	240	227
August	199	198
September	177	174
October	176	158
November	164	143
December	177	150

The lines run nearly parallel, the negroid death being always nearly twice that of the white. In February the negroid death actually exceeds the white, January, March, November and December show a better condition for the negroids, the rate tending toward the correct proportions.

ANTHROPOLOGY AT JOHNS HOPKINS UNIVERSITY.—Under the editorial supervision of Mr. Herbert B. Adams is published monthly the "Johns Hopkins University Studies in Historical and Political Science." Several of these pamphlets, issued in 1884, have immediate bearing on anthropological science. "Institutional beginnings in a Western State," by Jesse Macy, A.B., No. 8 of the second series, appeared in July. This is a careful study in the early history of Iowa from meager documents and from the mouths of living witnesses. Nos. 8 and 9 of the second series, fifty-one pages, by William B. Weeden, A.M., is entitled "Indian money as a factor in New England civilization." The Indian wampum became established in colonial life as a medium of exchange, and contracts were made payable at will in wampum, beaver or silver. For more than a century this currency entered into the intercourse of Indian and colonist, affecting the whole development of industry and commerce. To trace this influence is the purpose of Mr. Weeden's paper. No. 11 is upon "Rudimentary society among boys," a pamphlet of fifty-six pages, by John Johnson, A.B. This is a charming study of the attempts made by the boys of the McDonough farm school, near Baltimore, to imitate their elders in managing their affairs. No. 4, third series, is by Richard T. Ely, Ph.D., and discusses "Re-

cent American socialism" in a paper of seventy-four pages. This monograph is a revised edition of an able series of articles published, in 1884, in the *Christian Union.*

THE DAVENPORT ELEPHANT PIPES.—Mr. Charles E. Putnam, of Davenport, Iowa, has published a pamphlet of thirty-eight pages as a vindication of the authenticity of the elephant pipes and inscribed tablets in the museum of the Davenport Academy of Natural Sciences, from the accusations of the Bureau of Ethnology of the Smithsonian Institution. Those who have known the history of Davenport Academy, its struggles and triumphs for the love of pure science, and the extreme caution of its leading members, regretted that anything should appear in a Government publication reflecting upon their veracity or honesty. Tablets are common enough, being made of slate and other material and worn to-day by the present Indians of British Columbia and Alaska. So long as they do not contain outlandish and unclassifiable inscriptions there is nothing mysterious about them. On the contrary, the elephant pipes are mysteries. When I try to put the cast which we possess at the museum with something else, there is nothing to put with it. Professor Henry once said to one of his assistants who discovered an unclassifiable specimen: "That seems to stand out so unsociably that we must call it an 'outstanding phenomenon,' and wait patiently until something else turns up to go with it." The last word that should fall from the lips of a brother naturalist is "fraud."

On the other hand, barring this indiscretion, Henshaw is just what Major Powell says about him. He is a very careful and skillful naturalist. We should hail with delight the accession of all such men to the ranks of archæology because they bring light from every side to bear upon our mysteries. It should not make a particle of difference to any of us whether a pipe is the figure of a crow or of a toucan, so long as we know just what it represents. We may rest assured that for a long time every mystery solved will be accompanied by two quite as inexplicable.

But, really, too much account is being made of the matter. Squier and Davis are not overthrown. Their manatee, toucan and paroquet may be shot down by the ornithologist, but these practical gentlemen did not care a fig about such creatures. They made the greatest archæological survey and collections ever attempted in America, and their volume will indeed be a "monument" to their memory and to the glory of its authors for all time.

The Davenport Academy is not annihilated. Even if our theory should turn out true and the elephant pipe should prove a tapir pipe, and we should learn that tapirs once lived in the Mississippi valley, this grand association would survive.

MICROSCOPY.[1]

SOME HISTOLOGICAL METHODS BY DR. C. S. MINOT.—*Müller's Fluid.*—In hardening in Müller's fluid it is important to keep the jar with specimens and fluid in a cold place, best near freezing, for three or four days. The delicate tissues are then much better preserved; probably the same is true of Erlicki's fluid. Using Müller's fluid at a high temperature is bad for epithelia.

Beale's Carmine.—

Carmine	1 gram.
Ammonia	3 c.c.
Pure glycerine	96 c.c.
Distilled water	96 c.c.
Alcohol, 95 per cent	24 c.c.

Dissolve in the ammonia plus part of the water; add the rest of the water and allow to stand in an open dish in a warm place until the ammonia is nearly all driven off. Then add the alcohol and glycerine. For use, dilute with an equal part of glycerine, which must be thoroughly mixed in by stirring. Stain in an open dish, which, together with a second open dish containing acetic acid, is placed under a bell glass or in a closed box. The staining requires at least twenty-four hours, and much longer if the carmine is fresh. Beale's carmine improves with use, and what is left after being employed as directed should be filtered back into the original bottle.

From the carmine solution the sections are placed in water and washed *thoroughly*, after which they are placed for 1–3 minutes in hydrochloric acid diluted with water until it tastes about like sharp vinegar. They are finally again washed in water and are then ready to mount in the usual manner.

Employed in this way Beale's carmine is one of the most valuable of histological staining fluids, both for general use and also more especially for the central nervous system. If by any chance the sections are overstained, the superfluous color may be extracted by a *brief* sojourn in *very dilute* ammonia (one drop of strong ammonia to 5 c.c. of water is quite sufficient), this is to be followed by a rapid washing in water and an immediate transfer to dilute hydrochloric acid.

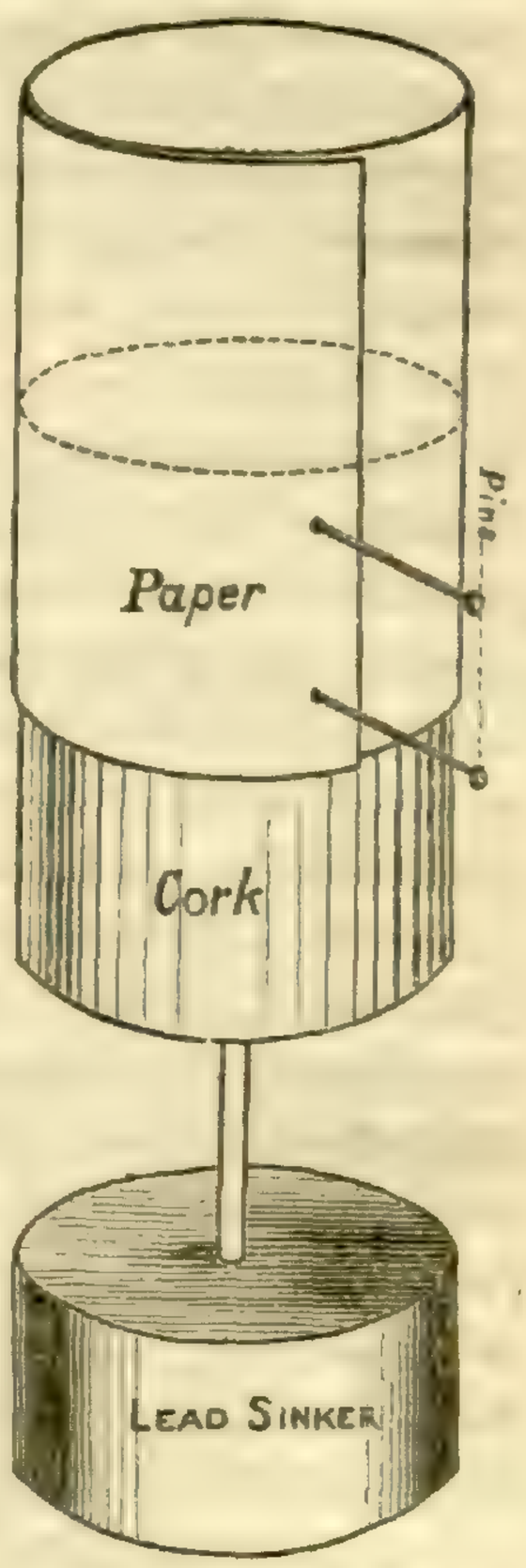
Eosine in Alcohol.—Best strength for staining is 0.0005. Dissolve one-half gramme eosine in one liter ninety-five per cent alcohol, or dissolve one gramme in 100 c.c. alcohol, and for use dilute one part of the stock solution with twenty parts alcohol. The alcoholic solution is far more convenient than the aqueous.

Imbedding in Celloidin.—The object after having been thoroughly dehydrated in alcohol is placed for twenty-four hours in a mixture of equal parts of strong alcohol and pure ether. If this mixture is kept long a little ether must be added from time to time.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

Transfer to a thin solution of celloidin, and allow it to remain for from one to three days, according to the size of the object.

Imbed in a thicker solution of celloidin. This is best done as follows: A cylindrical cork of convenient diameter is selected; a strip of glazed paper wrapped round it tightly and fastened with a couple of pins as indicated in the figure. In the box thus formed the object is placed and the celloidin poured carefully over it. If necessary the object can be secured in any position by pins. Bubbles will rise from the cork and interfere with the imbedding; two precautions will essentially diminish this danger: 1. Pour in so much celloidin that it covers the object half an inch deep, giving an opportunity for the bubbles to rise above the tissue; 2. Before imbedding cover the end of the cork with a thin layer of celloidin, which is allowed to dry on completely. After the object is covered the cork is mounted on a lead sinker (see figure), and allowed to stand until a film has formed on the upper surface. It is then immersed in alcohol of 82–85 per cent (stronger alcohol attacks the celloidin) for one to three days. I have found it best to allow plenty of time for the hardening after imbedding.



The sections have to be cut under alcohol; we use Jung's microtome with his largest knife, placed so as to cut with as much of the blade as possible; if the edge is good, then the longer the draw the thinner the sections which can be made. While cutting the knife blade should have as much alcohol upon it as possible; to secure this we use the dripping apparatus described below. The sections should be removed from the knife with a fine brush, to avoid all risk to the edge. For celloidin imbedding are needed:

1. Mixture of ether and alcohol, equal parts.

2. A thin solution of celloidin in (1). This should be syrupy but still flow easily.

3. A thick solution of celloidin in (1) of about the consistency of thick molasses.

The usual mistake is to have the solution too thick. Quantitative directions cannot be given because the celloidin varies in weight according as it is more or less dried.

Celloidin is a purified gun cotton, manufactured by E. Scherring in Berlin, Germany. It may be obtained in Boston of the Prang Educational Co., and of the Educational Supply Co., in ounce boxes, at $1.25. It is a most valuable and important addition to the resources of the histologist, as it enables him to make thin

sections of large objects; and in these sections all loose bits of tissue are kept *in situ* by the celloidin which does not interfere with the staining or mounting. If for any reason it is desired to remove the celloidin, a little ether and alcohol will dissolve it from the section almost immediately. For the study of loose parts, where the sections would otherwise fall to pieces or require difficult manipulations, such as the placenta or brain, celloidin may, I think, be safely said to surpass any other material hitherto employed.

For mounting sections with celloidin left on them I have found none of the methods hitherto recommended satisfactory. The essential oils I have tried either dissolve the celloidin like oil of cloves, or cause it to shrink and distort the section like oil of Bergamot. After trying various reagents, I have settled upon chloroform as the most convenient medium of transfer from alcohol to balsam. In using it care must be taken to place the section for half a minute in perfectly fresh alcohol, which is really 95–96 per cent; if this is done chloroform will clear it up almost immediately. When the section is in chloroform on the slide, the mounting must be expeditious, and the balsam added *while the chloroform is still covering the section.* If many sections are to be mounted, it is convenient to have a dish full of chloroform and large enough to permit plunging in the slide and placing the section on it, all under chloroform. The transfer, particularly of a large section, from the spatula to the slide, with chloroform, is often VERY difficult. To mount a single section, put it in alcohol on the slide, wash with a few drops of fresh strong alcohol; let most of the alcohol drain off, but while the section is still covered with it add chloroform, drain off the mixture, and pour over the still moist section a fresh dose of chloroform; if the washings have been really thorough the sections will clear at once.

MICROTOME KNIVES.—The Scientific Instrument Company of Cambridge, England, are preparing an automatic machine for sharpening microtome knives, which, it is to be hoped, may prove to be just what every microtomist so much needs.

It is easy enough to find men skilled in honing ordinary razors, but not so with the microtome knives. Numerous and repeated trials have been made among the most hopeful experts in and about Boston, but in no case have the knives been returned in an acceptable condition, and sometimes they have been much damaged or wholly ruined. The best test for the condition of the edge is to try it on the palm of the hand. A knife that will not cut a ribbon of paraffine sections .005^{mm} thick is not fit to use; the best knives should cut as thin as .001$^{mm.}$ It is not often that it becomes desirable to cut so thin, but it is important in making thick sections ($\frac{1}{50}$—$\frac{1}{100}$^{mm}) to use a knife that has a much finer working capacity. A thoroughly sharp blade may have very

nearly a horizontal position for its lower (plane) surface in sectioning, while a duller one requires to have its back raised a little above the level of its cutting edge. It is safe to say that a knife cuts well when thin sections (.005^{mm} or less) *agree in size with the cut surface of the paraffine block.* It may be possible to cut a straight ribbon with a dull knife, but in this case it will probably be found that the sections are shortened in a direction at right angles to the edge of the knife, which shows that the knife is acting the part of a plough, which crushes more than it cuts.

The statement that a sharp knife may have a nearly horizontal position must be understood to have some limitations. In general it may be said that the larger and harder the object the more imperative it becomes to have the under surface of the blade slant towards the object, and the necessity for this is greater with a transverse than with an oblique knife. For very hard objects a relatively thick-edged knife is required as well as a slanting position.

For ordinary histological or embryological work, the upper surface of the blade is ground hollow, the lower surface plane (Fig. 1 *k*), the edge being left very thin so that an extremely slight bevel is made in setting. What bevel there is should be mainly on the upper side. The edge when examined with a magnifying power of a hundred diameters should be perfectly straight and *smooth.*

FIG. 1.—Diagram illustrating the position of the knife in sharpening. *k*, knife; *s*, oil-stone; *w*, wire.

Method of Sharpening.—Microtome knives can be properly sharpened only by those who understand their chief peculiarities, and who have trained themselves in this special work. The difficulties in acquiring the art are not, however, insurmountable; for with the proper means and a little perseverance they can be mastered in a short time. The first important step is to provide oneself either with a good razor strop (those made by Zimmermann in Berlin are considered excellent), or with a long and wide oilstone of the finest quality. Strops made of a leather band, unsupported by a solid base, and kept tense by the aid of a screw working in a frame, should never be employed in sharpening these knives, for they invariably give a bi-convex edge, with which it is impossible to do fine work. To secure a *plane* bevel of the cutting edge the surface of the strop must be perfectly *smooth, flat* and *hard.* In using the strop the knife is drawn back and forth, back foremost, *without* pressure, until the edge appears sharp when tested in the manner before mentioned.

In using an oil-stone it is well to cover the surface of the stone with a mixture of glycerine (two parts) and water (one part), as recommended by Fol.[1] The blade is laid flat on the

[1] Lehrbuch d. Vergl. Mikr. Anat., p. 129, 1884.

stone and pushed *forward, edge foremost*, in such a manner that the free end of the knife finishes by resting on the more distant end of the stone. Here the blade is turned on its back and returned, edge in advance as before, to the place of starting. In drawing the blade the utmost care should be taken *never to raise in the slightest degree the back from the stone;* and *further the knife must not be pressed on the stone, but held lightly by the finger-tips*, and the *necessary friction be left to capillary adhesion.*

After drawing the knife fifteen to twenty times it should be tested as before.

The knives furnished with the Thoma microtome should be provided with a wire support (Fig. 1 *w*) for the back of the knife during the process of sharpening.

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SCIENTIFIC NEWS.

—The results of the Hudson's Bay Expedition, in 1884, under Lieut. Gordon, possess much interest, and Dr. Bell's report on the geology of the extreme northern shores of Labrador, as well as of Hudson's strait, contains new matter especially relating to the glaciation of that country. As to the botanical collections made, Prof. Macoun affirms that it shows conclusively the arctic character of the climate of the straits and that part of Labrador north of Nachvak. Raised beaches, 300–400 feet high, were observed on Hudson's strait. Ancient stone structures, erected by the Eskimo, were observed, and Dr. Bell observes: "From what I have seen of the situations which the Eskimo in various places in Hudson's bay and strait choose for their camps, there appeared to be little doubt that they had lived here when the sea-level was 20 to 30 feet higher than it is at present."

The observations made shows that the basin of Hudson's bay may have formed a glacial reservoir, receiving streams of ice from the east, north and north-west and south and south-west. The direction of the glaciation on both sides of Hudson's strait was eastward. "That an extensive glacier passed down the strait may be inferred from the smoothed and striated character of the rocks of the lower levels, the outline of the glaciated surfaces pointing to an eastward movement, the composition of the drift, and also from the fact that the long depression of Fox's channel and the strait runs from the north-westward towards the south-east, and that this great channel or submerged valley deepens as it goes, terminating in the Atlantic ocean. Glaciers are said to exist on the shores of Fox's channel and they may send down the flat-topped icebergs which float eastward through the lower part of Hudson's strait into the Atlantic. During the drift period, the glacier of the bed of Hudson's strait was probably joined by a contribution from the ice which appears to have occupied the site of Hudson's bay, and by another also from the southward, coming down the valley of the Koksok river, and its continuation

in the bottom of Ungava bay. The united glacier still moved eastward round Cape Chudleigh into the Atlantic."

Farther observations on the geology and natural history as well as ethnology of this region are desirable, and will be made during the season of 1885. The steamer *Alert*, in command of Lieut. Gordon, R. N., left Halifax, May 30, Dr. Bell being the scientist of the expedition. Stores sufficient for more than a year will be taken to provide against any emergency. The round trip is expected to occupy five months. The stations to be visited are Port Burwell, near Cape Chidleigh, Ashe inlet, near North bluff, Stupart's bay, near the Prince of Wales Foreland, Nottingham island, Digges island and Nachvak bay, all of which were founded last year. These stations will all be continued, except the last named, which will be dispensed with on the score of economy. Lieut. Gordon expected to reach Hudson's strait by June 10. Provisions for the ensuing year and eighteen tons of hard coal will be left at each station. A large quantity of evaporated vegetables will be taken to the stations. Forty applications have been made for positions as observatory men. Much valuable information is expected to be gained from the observations made during the past year as to the formation and breaking up of the ice and in regard to its movements, also relative to the navigation of the strait. After leaving Fort Churchill, a running survey will be made on such portions of the eastern shore of the bay as are practicable. The *Alert* is expected to arrive back in the strait about August 25, and the remainder of the time will be occupied in surveying as much of the coast of the strait as is possible.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, March 24.—Mr. Garrison communicated the results of his examination of slag from an iron furnace.

Mr. A. H. Smith and Mr. Edw. Potts described borings in the vicinity. One in Cumberland county, N. J., reached a depth of 650 feet, and at 570 feet passed through a bed of oyster shells, stated by Professor Heilprin to be almost certainly Cretaceous.

Dr. Leidy spoke upon the giant extinct sloths, and stated that among fossils received last year from New Iberia, La., were three teeth, a close study of which indicated that the form described by Owen as *Mylodon harlani* should be returned to the genus Orycterotherium, in which it had been placed by its discoverer, Harlan.

Mr. Eastlake presented Entomologia Hongkongensis, and Mr. A. F. Gentry a description of a supposed new species of Cyanocorax.

March 31.—Dr. Horn referred to certain sexual characters separating forms of the Staphylinidæ. The gradual disappearance of these forms might be considered as an instance of nature's

indication of intention. He also referred to modifications in the tarsal joints of the Silphidæ, described in a paper by a Belgian entomologist. The number of joints in tarsi and antennæ underwent gradual reduction, but the speaker considered that in view of the intermediate conditions it was ill-advised to give importance to the presence of the smaller number of segments.

Professor Heilprin believed that in Palæozoic times no such zoölogical zones as now occur existed. For instance, no existing Brachiopoda are cosmopolitan, while those of ancient times were much more widely distributed. The presence of corals, graptolites, etc., in widely separated regions, indicated the former presence of a temperature much more uniform than the present. The speaker then drew attention to points which seemed to invalidate the opposite conclusions arrived at by Professors Neumeyer and Roemer. Though not a single New Jersey species of the present day is found in the Gulf of Mexico, fifty or sixty species of fossils out of 150 from the northern locality are found in Mississippi and Alabama, while only ten out of 200 fossil Texan forms are found in Mississippi, showing conclusively that climate was not the former cause of distribution. These zones were gradually established during some period of the Tertiary. Referring to the pebbles obtained by Mr. A. H. Smith from a boring of 170 feet on Black's island, Professor Heilprin stated that they came from a glacial gravel, probably the Trenton. The boring had now, at a depth of 195 feet, reached a bed of plastic clay.

A paper entitled, Remarks on *Lanius robustus* Baird, by Leonhard Stejneger, was presented.

April 7.—Mr. Morris spoke upon the question, Why are there no fossil forms in the strata preceding the Cambrian? He called attention to the fact that the oldest animals known were covered with protective armor, but without weapons of offense. Of the predatory foes whose presence rendered this armor essential we know nothing. The armored forms probably represent earlier free-moving forms, driven to wear heavy armor for protection, and by the weight and character of the armor, forced to take up a life on the ocean bottom. It was late in the history of life that animals began to secrete an internal hard skeleton, and though the external hard covering was acquired earlier, life may have prevailed a long time before this adaptation was gained. Yet fossilization was not possible until these hard external coverings had been acquired, while the existence of large land animals was not possible until an internal skeleton had been acquired. If these conclusions are correct we can never hope to obtain more than a fragment of the antique fauna.

Dr. Leidy read a letter from Dr. Neal, Archer, Fla., announcing the discovery of another bed of fossil bones about twenty miles from that found a year ago. Two or three feet below the surface was a bed of cinders and charred bones, and above this were found fragments of the teeth of a rhinoceros, probably *R. protersu.*

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THE REPUTATION OF THE LANTERN FLY.

BY JOHN C. BRANNER.

IN nearly every part of Brazil one may hear the most incredible stories of a deadly insect, the very name of which inspires the greatest awe. When I first heard these stories of the terrible *gitiranabóia*, *tiranabóia*, etc., as it is called, I was naturally rather skeptical, but continually hearing them repeated and testified to, not only by the common people but even by men of education and standing, and seeing in print accounts of the devastation wrought by this insect, I was finally induced to inquire into its existence and character.

To give an idea of the popular opinion of the *gitiranabóia*, I need only give a few specimens of the stories that are told of it. The prevailing opinion is, that it is about the size of our seventeen-year locust or a little larger, having a long poisonous beak projecting from its large head; that it has great powers of flight, and when, in its wild career, it strikes any living object—if an animal, no matter how large or powerful—it falls dead upon the spot; if a tree it soon wilts and dies.

A certain distinguished Brazilian engineer corroborated the general truth of these stories, and assured me that along the Amazonas a monkey might sometimes be seen among the topmost branches of a lofty tree, when all of a sudden he would come tumbling down dead, without any apparent cause, struck by the fatal *gitiranabóia*. An extract from a Spanish American newspaper was shown me a couple of years ago in which this insect was spoken of as destroying the cattle of Brazil in the grazing country of the southern provinces. In Pará I was assured that

it was known to have stung a child which died a few days afterwards in great agony, and in spite of all the physicians could do.

Many such cases were mentioned to me in various parts of the empire, and although on several occasions I met persons who claimed to have seen the insect itself, I was never able to come upon an actual case of injury done by the insect, or to see any one who had seen it wound the offended party.

Search for the *gitiranabóia* itself was nigh proving futile also, but by dint of perseverance, cross-examinations, the sifting and patching together of evidence, I succeeded finally in cornering this destroyer of life in general and of the human race in particular. Some of my informants told me that it folded its long beak beneath its body when it was not angry or bent upon destruction. Here, perhaps, was one character. Others said that its head was very large in proportion to the rest of its body, in size and general form much resembling a peanut. Others again told of its being blind, though it appeared to have large eyes on the sides of its big, ugly head, while others added that this head was luminous. These characters pointed plainly to the *fulgore* or *porte-lanterne* of the French entomologists.

Before trying to clear its character I took pains to assure myself that the *Fulgora lanternaria* is the so-called *gitiranabóia*, and that it is generally supposed by the common people of Brazil to be poisonous. Just here trouble began again, for once I could show that this insect was neither luminous nor harmful, it would be stoutly declared that "in that case this was not the *true gitiranabóia*." And this is exactly what happened.[1]

Along the coast south of Bahia[2] the *gitiranabóia* is called the *bicho do pau parahy'ba*, because it frequents the tree there known as the *pau parahy'ba* (*Simaba versicolor* St. Hilaire).

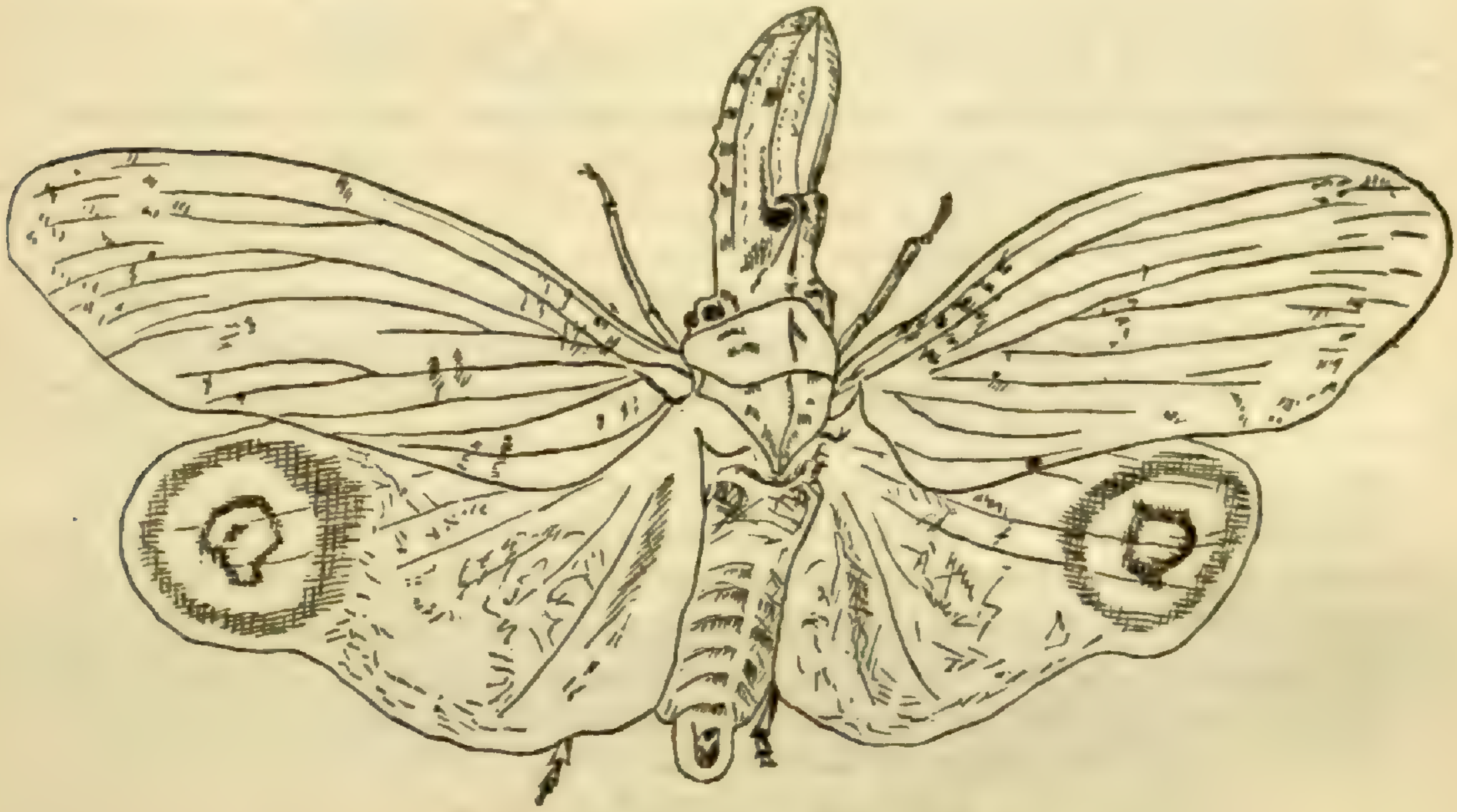
On one occasion a living specimen was taken to Bahia as a great curiosity, and exhibited on exchange, where it was looked upon and treated with the greatest respect. Dr. Antonio de Lacerda, a Brazilian gentleman who takes an active and intelligent interest in entomology, saw the specimen and heard the countryman's story of the death of a person caused by this very

[1] I had a very similar experience in Brazil with a certain snake. The reputation of the *salamandro* was, if anything, a little worse than that of the *gitiranabóia*, but when the snake was found, and I showed that its bite was not fatal, or even very painful, I was told: "Then that is not the genuine salamandro."

[2] Specimens of these insects can be had of dealers in Bahia for about 50 cents each.

insect. He laughed at the seriousness with which the story was received, refused to believe that it had injured any one, and to the horror of every one present, took the insect in his hand and repeatedly thrust his finger against the point of its beak which was said to be so deadly. I mention this case especially to show that there can be no doubt about the identity of the insect. Dr. Lacerda also showed me specimens of it in his own collection.

Another proof of its identity is given by Pompeo de Souza in his Ensaio Estatistico da Provincia do Ceará, p. 216. Among the insects of that province he mentions the *tiranabóia*, which, he says, "is supposed to be poisonous, but there is no fact to justify this story." A dried specimen was sent him from the interior, and he declares it to be a hemipter.



Fulgora lanternaria. Natural size.

It goes without saying that this *gitiranabóia* is perfectly harmless. It may be added also that its scientific name is a misnomer as far as it relates to its producing light. I was often assured that its head was luminous, but I have never met a single person who claimed to have seen this luminosity. Snr. Luiz A. A. de Carvalho, Jr., of Rio de Janeiro, who has several species of these beautiful insects in his collection, assured me that he knew of no evidence whatever that they produced light. Prince Maximilien de Wied-Neuwied says on this subject: "Nous n'avons jamais aperçu le moindre vestige de la luerer éclatante du fulgore porte-lanterne (*Fulgora lanternaria*) quoique nous avons souvent pris cet insecte sur les arbres."

Instances of extravagant stories of this kind are not uncommon in Brazil. The case of the *salamandro* already referred to is a good example. Another is that of a plant, a species of smilax, which is said to grow from the dead body of a Cicada. Belief in this story is so general that through some parts of the country a certain plant is popularly known as the *japecánga da cigarra*, or cicada smilax. Those who claimed to have actually seen this phenomenon represented that the plants seen by them were all quite young. Doubtless they were cases of larvæ killed by parasitic fungoid growth.[1]

Such stories come, of course, from imperfect observation, and have an air of truth about them derived from their association with known objects or facts.

NOTE.—We are unable to find any reference in entomological works as to the poisonous nature of this insect, which is undoubtedly perfectly harmless. It is, however, disputed whether the insect is luminous or not. See Westwood's Introduction to the Modern Classification of Insects, II, 428, where after referring to his figure of the head of *Fulgora lanternaria*, he says it "is the part of the body asserted by various writers to emit a strong light by night, analogous to that of the fireflies." The account of the luminosity of this insect originated with Madam Merian, but it was denied by Olivier, in which opinion Hoffmansegg, the Prince Von Nieuwied and Lacordaire concurred. "M. Wesmael has recently reasserted the luminous property of the South American species on the authority of a friend who had witnessed it alive. And W. Baird, Esq., has informed me of the existence of a Chinese edict against young ladies keeping lantern flies." In our Guide to the study of Insects (p. 533) is the following statement regarding the East African lantern fly: "Mr. Caleb Cooke, of Salem, who resided several years in Zanzibar, Africa, informs me that the lantern fly is said by the natives to be luminous. They state that the long snout lights up in the night, and in describing it say "its head is like a lamp" (keetchua kana-tah).—*A. S. Packard.*

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AGE OF FOREST TREES.

BY JNO. T. CAMPBELL.

THE age of trees that have an exogenous growth is correctly indicated by the concentric rings of growth shown in their cross-section. These rings also, when correctly interpreted give a true history of the tree from its infancy to maturity and old age; showing correctly the dates of prosperity and adversity in the career of the tree.

[1] Comte Charles d'Ursel, in his Sud Amérique, figures and describes, after a fashion, "l'insecte qui devient plante," found in Brazil. Speaking of the plant, he says that "au printemps elle se couvre de fleurs bleues," p. 107.

One ring is formed each year between the bark and the previously-formed wood. If there is a large healthy top of branches, these concentric rings will be relatively large, especially so if the tree is not overshadowed by older and larger ones. During the past fifteen years there have been thousands of white oak trees sawed down in this country (Western Indiana) for staves, and I have taken the time and trouble to count the ages of several hundred of them; also the ages of other forest trees; but my observations of the oaks have exceeded those of all other kinds. I was led into this investigation by reading an article in a newspaper purporting to be copied from some scientific magazine, the name of which I have forgotten, which article claimed, not only confidently but positively, that the large rings of growth indicated past wet years in Kansas, or years favorable to vegetation, and that the small rings indicated past dry years, or years unfavorable to vegetable growth. The article stated that the count from the outside ring inwardly coincided with the past seasons historically as far back as the whites or Indians had any tradition of the seasons. The article further stated that some English scientific journal had published an article by some traveler up the Nile, in Egypt, who had made the same discovery there. He had counted the rings on the oak stumps there from the outside inwardly, comparing them with the years counted backwards, and had made the startling discovery that the seven years of plenty followed by the seven years of famine during Joseph's rule in Egypt, were actually and accurately registered on the stumps. Sometimes an absurdity is so plain that nobody sees it at all. This is one of that sort. It did not then occur to me that a tree old enough to keep books in Joseph's time would, if living now, be about twenty-five feet in diameter, if it grew like an average Hoosier oak. But the story had a charm for the credulous, and it led me to estimate the age of trees here, and to compare the large and small rings with the years of plenty and the years of famine. To my surprise, and considerable disappointment, there was no coincidence whatever between them. I found stumps of trees of the same species, the same size (and presumably the same age) standing within twenty feet of each other, on the same kind of soil, cut down the same year, and, so far as I could judge, subject to the same conditions throughout, one showing a large ring where its neighbor would show only an average one, and in some few

cases they showed the opposite—one large and the other small. I examined enough to prove that whatever they might show in Kansas or in Egypt, they showed nothing of the kind in Western Indiana.

I have not been, so far, able to account for the spasmodic production of single rings of large or small growth, interspersed here and there among those of the average size. But when a succession of large, and especially small, rings prevail, say from ten to seventy-five or more, I can see a possible cause producing them, and have strong circumstantial evidence that such is the very probable cause of the large or small rings. Trees are like men in some respects. More are born than can live; more live than thrive; more thrive than can be masters.

"The young cannot hold sway
Till the old are dead and out of the way."

The tree that falls behind its fellows in the race of life will very likely fall behind the more active of the next generation also. Many are crowded and smothered out in infancy by their more vigorous brother infants. Nature is not generous or charitable. She knows but one law of growth: "To him that hath, shall be given; to him that hath not, the little he hath shall be taken away." When a tree gets but little the start of its immediate fellows, all the nourishment of nature seems to be offered to it, instead of its more needy neighbors. And to the weakest, nature gives next to no sympathy at all. I have seen two trees of the same species, the same age to a year, standing side by side, the one three times the diameter of the other and more than twelve times the solid contents counting increased length. Both were equally healthy, but the smaller had long ago been beaten for the nomination to leadership in convention, and had dropped back among and remained one of the mere constituents. The first rays of the morning's sun fell on the larger tree. The smaller one had to wait till eleven o'clock for sunshine, and was cut off at 2 P. M., while the larger one received it till sundown. If there was only a small shower the larger one got it. The smaller one got no rain except from heavy showers which leaked through the top of the larger one. In such a case the larger tree would have large concentric rings, while the smaller one would have them so fine they could be counted only under a magnifying glass. I have often seen just such cases.

I have been a civil engineer and land surveyor since 1867, and as such have had occasion to examine many trees referred to in the field notes. The United States surveyed the land into sections of one mile square each, and drove stakes at the section corners, and also at the quarter section corners equidistant between the section corners. They also blazed two trees near these corners about one and a half feet above the ground, cutting a small notch in the blaze, and gave in the field notes the size and species of the trees marked, and their courses and distances from the corners.

About fifty years had elapsed between the date of the survey and my day as a surveyor. Many of these trees could be identified at sight by the scar where the blaze was made. In other cases the tree would be so much larger than the size given in the field notes that the blaze would be obliterated by the spread of the bark, and the doubt would have to be settled by chopping into it at the place indicated by the notes. If we found the blaze and notch, we next counted the rings from the outside into the blaze. If the count of rings tallied with the date of the survey—all well. Mark a new tree and record it in what we call the subsequent field notes.

In the year 1868 or 1869 I was making a survey in the eastern part of the county. At a certain corner wanted, the field notes called for an ash three inches in diameter. The only ash near and answering to the locality, was about eighteen inches in diameter. Nobody expected to find so large a tree in the fifty years that had elapsed since it was marked. But on chopping into it we found the blaze and notch near the heart, revealing the unmistakable fact that it was the real "witness tree," and that it had been marked by a left-handed chopper with a dull axe. A look at the ground and timber about the corner showed the further fact that just before the original (United States) survey was made, a tornado had passed over that place and blown down all the adult trees, as all the present ones were young and thrifty, and the graves of the fallen trees were as plain as any mark could be. A tree-grave is easily known; as the tree falls the roots hold a considerable quantity of earth in their grasp, which leaves a large hole in the ground under where the tree stood. In time the body and roots will rot, leaving the dirt piled up on the side of the hole the tree fell on, and it looks as if a grave had been dug with

the dirt all cast out on one side, and the corpse had got away and the grave remained unfilled. This tree had increased six times its diameter, and more than thirty-six (and counting the increased length nearly seventy-two) times its solid contents since the government surveyors had marked it.

The next year I made a survey in the rough hills of Sugar creek in the north-east part of the county, and in identifying a land corner I had occasion to examine another ash described in the field notes as three inches in diameter also. It stood on the point of a sandstone ridge, between three large white oaks, which formed a triangle around it, and were about fifteen feet apart. This ash, the same species as the one before described, had not grown to exceed one-half inch in the increase of its diameter in the fifty or fifty-one years since it had been marked. This would allow only one-fourth of an inch on each side; yet I counted under a magnifier, in this small space, the required number of rings of growth. They were thinner than common book paper, as they were at the rate of two hundred to the inch. This tree had increased only thirty-six per cent in fifty years, while the former had increased about seven thousand per cent in the same time. Why this difference in the size of these two ash trees? The reasons are plain. The former had a good soil on level ground, and the tornado had destroyed all the adult trees that would rob it of sunshine, rain and soil nourishment. The latter stood in dissolved sandstone for soil, on the top of a narrow ridge between three large oaks, which robbed it of sunlight and rain, and nearly all the soil nourishment. It had but five or six small branches for a top, and but few leaves to the branch. Under such conditions it did well to even exist. But to do this it was obliged to add a ring each year.

Eleven years ago I examined the stumps of two white oaks and the grave of a third, which told this singular story by circumstantial evidence so strong that it could not be doubted. In the year 1502 an acorn fell about one and a half miles from where I am now writing (Rockville, Indiana), and by favorable chance sprouted and grew into an oak. In 1594 another acorn sprouted about twenty feet distant from it. It may have grown on the tree before mentioned, as it was then ninety-two years old. In 1731 a tornado from the north-west blew down a still older oak, which in its fall struck against and greatly damaged the top of the one

born in 1502. There is to-day the well-marked grave of the fallen giant, the dirt piled upon the south-east side of the hole, and a long depression in the ground where the trunk fell and rotted till not a vestige of its wood can be seen to-day (though some traces of the bark of the roots can). This depression points to the stump of the damaged oak. The two younger had been freshly cut down when I examined them. Their stumps were about four feet across, and there was not over an inch difference between their diameters, though ninety-two years difference in their ages. The younger had a large, healthy top, no broken or dead limbs, and it had put on rings of growth from the beginning of more than average size. The older one had been injured in its branches by the fall of the still older one before mentioned (in 1731) and for fifty-seven years had put on very small rings of growth (about twenty-five to thirty years to the inch instead of twelve to fifteen as it should), when a new set of branches developed to take the place of the damaged ones, and the rings began to increase in size and gradually attained to the average. I examined their tops, which coincided with what has gone before. There were the peculiar knots in the top of the older one where dead limbs had rotted off and were healed over. (Any expert timberman will readily recognize them.) During this delay the younger oak caught up with the older one in size. The size of a tree is a very uncertain indication of its age.

In all the cases of the hundreds I have examined of the oaks (the oldest trees of the forest I think), I never saw but one that was here when Columbus discovered America. That one was by far the largest I ever saw, and was over six hundred years old, about twice the age of the other largest ones. I could not get its exact age as it was so decayed near the heart I could not distinguish the rings. It was between six and seven feet in diameter, and forked about sixty feet up, and each fork was as large as the other largest trees. It was not sound enough to make good lumber, being what in this region is called "doughty," a state between soundness and rottenness. It had been down a year before I examined it (being out of the county when it was cut), so that it was very difficult to examine it. I have mislaid my memorandum of it, but it would be about as follows: At the age of about two hundred years it had some ill-fortune which caused it to form about one hundred small rings. It then regained its

health and formed normal rings for about one hundred and forty years, when another mishap caused small rings till within the last fifty years, when it was putting on fair growths again. This tree was about one and a half miles south-east of Rockville, Indiana, and was noted among hunters and woodmen. It was a disagreeable showery day when I examined it, and for that reason I did not examine its top to see if dead and lost and healed-over limbs coincided with the small rings, but I have often done so in other cases, and found them to coincide.

Last May (1884) I examined a sycamore and water elm in the Wabash river bottom, the former six feet in diameter and the latter five, each one hundred and eighty years old. They stood about one hundred and fifty feet apart. They were standing on the upper end of a newly made bottom (I mean new as compared with the higher and older bottoms a little more inland from the river, say two hundred years old). This was the largest sycamore I ever saw that was sound to the heart. I have seen hollow ones nearly eight feet in diameter. This tree seems never to have met with any mishap till the log man came along, as the rings of growth were all unusually large.

These trees very probably sprouted twelve to fifteen feet below the present surface of the bottom. They generally begin life on the lower end of river sandbars, and as sedimentation builds up the surface, they put out new surface roots at every two to three feet of elevation. Such trees with their several sets of surface roots, are often seen in drift piles, and also still standing on the verge of a steep river bank where one side is exposed by the erosion of the river. Their roots are often hollow like their trunks, the hollow (and root too) decreasing in diameter downward till it terminates in a point, like a cone standing on its point. In the south-west corner of this county is a hollow cottonwood stump on what is now a high bottom of the Wabash, in which the hollow extends downward twelve feet. Mr. Joseph J. Daniels, an intelligent, observing man, on whose land it stands, told me so. Such silting up over the surface roots would kill most of the upland trees, or those that grow from the seed on the high bottoms.

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 767, August number.)

IV. The Instrumentality of the Brain.

WE have, in the preceding sections, reached several conclusions as to the character, development and mode of operation of the nervous organism. We have next to consider this organism in its relation to the development of the mind. This is undoubtedly the most difficult of the whole broad scope of problems to which science has addressed itself. Much has been written upon it, but we can scarcely say much that is satisfactory. It remains yet in great measure an open question, though a far narrower one than of old. Science has strongly attacked the outworks, if not the citadel of the problem, and has effectually dispersed the cloud of immaterial existences about which the thoughts of men so long hovered. It is becoming clearly evident that all existence is based upon substance. It may not be that species of substance which we call matter. For all we know there may be many species of substance. Yet there is no resting-point between something and nothing, and immateriality sinks into the category of nothingness.

But we are able to bring the conditions of the mind much nearer to the ordinary conditions of the material universe than this. The old idea that the soul is brought full fledged from some distant limbo of souls, and implanted in the infantile organism, might serve for the philosophers of a mediæval dreamland, but can hardly be sustained in this wide-awake age. To us the germ of the mental organism forms part of the physical germ, and the whole development of the mind takes place through the influences acting upon the body. It is well known that the degree of the mental development is in close accordance with the variety and quantity of these external influences. If the body be closed against their entrance, through loss of the organs of the higher senses, the mind remains undeveloped. If all the senses were shut off and no external influence permitted to reach the germ of the mind, it must continue in the germinal state. In like manner if the senses be active, but the brain, the inner organ of the mind, be inactive or abnormal in condition, the mental development is similarly checked. All this needs no argument. Every one

must admit that the development of the mind takes place through the agency of external energies transmitted by the nervous mechanism.

But these energies are entirely motor. They are either radiant vibrations emanating from some distant substance, or the motions of molecules impressed upon the body through direct contact. Each of them has its special character, but they are all motions. In their transmission inward over the nerve fibers they continue to be motor agencies. They are now some mode of radiant energy. Those that pass through the ganglia and reach the muscles, prove their motor character by disturbing the motor relations of the muscle cells. Those that are retained in the ganglia, and yield other effects, must do so as motor agencies. It is simply impossible that motion can become anything else. Nor can it exist independent of substance. Nor can it cease to exist. Every quantity of motion must of absolute necessity continue to exist as the same quantity of motion. It cannot lose or gain quantity, or change into some condition that is non-motion. Nor can it exist as an immaterial condition. It is indissolubly wedded to substance.

These conclusions can scarcely be questioned by any scientist, yet they lead to certain important inferences. If the development of the mind takes place solely through the influence of special motions, conveyed to it over the channel of the nerves, then the mind must necessarily be based in substance, and its energies must necessarily be motor. The idea that an immateriality can be organized by motor agencies is a mere metaphysical phantasm.

But though a definite quantity of motion cannot lose or gain, its action upon matter may be almost infinitely varied. It may separate and become widely diffused, or it may become definitely fixed in a certain aggregate of matter. The organization of matter takes place solely through the influences of its inherent motions. The concentration of a crystal may be due to attraction, but its peculiar characteristics are undoubtedly due to the special motions of its particles. And an Amœba is superior in organization to a crystal solely through the vastly greater complexity and intricacy of the motions which affect its particles. In all these cases of aggregation the attractive agency seems to be single and unvarying in character. Its full effect is resisted by the

motion of the constituent particles, and with every variation in the vigor or complexity of these motions some variation in the volume, form or rigidity of the mass takes place. The reduced rigidity and varied constitution of organic cells is primarily due to the great absorption of heat or motor energy in the formation of their chemical molecules, and the variety of such molecules which enters into their constitution.

This consideration of the relations of matter and motion leads to a second. Motion may affect matter in either a general or a special mode. In the former case it tends to disorganize, in the latter to organize matter. Heat motion is a disorganizing influence. It constantly tends towards the disaggregation of matter. Electricity yields results partly of disintegration, partly of integration. Magnetism is a more specialized motor agency, and its effects tend to integration. The motor energies which enter into chemical phenomena are yet more varied and specialized, and tend strictly towards material organization. Thus the disorganization and organization of matter seem alike due to motor agencies. In the case of all organization the attractive affinities of chemical particles enter as an essential element. Motion, of whatever kind, may oppose these affinities, but it is quite possible for a definite harmony to exist between these two agencies. For instance, the solar system is a definite organism, due to the harmonized relations of its motions with its gravitative attractions. The same is the case with the earth as a whole, and with every crystal upon the earth. In the case of the solar system the disrupting activity of motion is overcome by its being forced into closed curves of rotation, yielding a fixed balance of energy between the two opposing forces. Something similar may exist in all organized masses. Every mass of fixed organization, whether it be earth, crystal, organic cell or animal body is subject to the opposite influences above named, those of attraction and motion, and its fixity indicates that a definite balance exists between these influences. Motion, therefore, may be said to be organizing when, by moving in closed curves or in other special modes, it becomes in harmony with attraction, the degree of concentration of matter depending on the comparative vigor of the two opposing forces.

All this may seem to have no relation to the problem of the development of the mind. Yet it is evident that motion is the

agent directly concerned in this development, and we can conceive of but one result of the agency of motion, that of change in the space relations of matter. The motion which enters the cerebral ganglion, and is retained there, cannot cease to exist. One of two things must happen. It may flow into the surrounding matter as heat, or in some other general and dissipating condition. Or it may become an organizing agent, and enter into some substance as a permanent factor. It may produce a mental compound of substance analogous to the inorganic crystal, and like the latter unchanging in form and in its internal conditions. The disorganizing energies of nature act upon the crystal. Heat and electricity pass through it but do not disintegrate it unless they become of excessive vigor. The same may be the case with the mental organism. This much we know, that the special motor energies which enter the body and are conveyed to the cerebrum produce those conditions which we call memories, and which are permanent and unchanging. If these are motor conditions they must be motions of organization, influences which partly overcome but which fall into harmonious relations with the force of attraction and condensation. And it follows as a corollary that the development of the mental organism from its germ to its highest unfoldment takes place through a continued succession of these organizing motor influences. The intricacy of the organism steadily increases, as it is affected by motions of higher complexity, but every motor state produced is permanent. The existence of higher motor conditions does not cause obliteration of the lower ones. This is one of the marked characteristics of motion. In the circle the straight line of motion is masked, not obliterated. In the spiral the circle persists. In the spiral vortex all these inferior stages can be traced. And in the organizing motions of the mind all inferior stages persist as constituent parts of the superior stages. Consciousness may be directed to any of these motor conditions, in which case they appear as memories. But consciousness has no bearing upon their existence. They continue through life active conditions of the mind, though they may seldom or never come within the sphere of consciousness.

The preceding argument is not advanced as anything new. It is rapidly becoming a common belief with scientists that the mind has its basis in matter, and that thought is a motor affec-

tion of this matter. The belief in the material basis of mind, indeed, has become a somewhat developed idea. It has of late years grown a more and more widely accepted opinion with scientists that the brain is the organ of mind, that mental conditions are motor affections of the matter of the brain, and that they can persist only during the persistence of the brain as a functional organ, and must return into the realm of unspecialized motions on the disintegration of the brain. Before considering this question it was necessary to obtain some idea of the general principles of relation between matter and motion, and of the conditions under which alone motion could be retained in a local mass of matter in a persistent and specialized phase.

In addition to a widely entertained opinion among scientists upon this subject, several authors have made it the special theme of their works, and have brought all the conclusions of anatomical and physiological science and the principles of the correlation and conservation of force in support of their argument that the brain is the only and sufficient mental organ. Of the authors who have treated the subject from this point of view may be named Bastian and Maudsley of England, Luys of France, and Moleschott, Vogt, Büchner and Haeckel of Germany. Many other authors might be named who have dealt with it more or less directly, prominent among these being Huxley. The converse has also been taken by several authors, yet none of them can be said to have squarely met the arguments of their opponents, and the most of them have dealt with it in the old and vague metaphysical method. So far as a scientific treatment of the question goes, the brain-mind theorists seem to have the best of the argument. And yet to the present writer their arguments seem the reverse of satisfactory, and their theories to need much stronger lines of evidence before they can be made self-sustaining.

That the brain is intimately and constantly concerned in the manifestations of the mind, no one will deny. But that it is alone concerned is far from being proved. The theories proposed by the several authors are the following: Huxley declares that sensation and consciousness are in some inexplicable way caused by molecular changes in the brain. This belief is based on the facts that thought and motion seem inextricably related, that every thought is accompanied by brain waste, that heat

appears as a consequence of thought, that mental action cannot go on without a constant supply of arterial blood and must cease periodically until the brain can regain its integrity through the assimilation of nutriment, and finally that no other organ of the mind can be discovered. The latter point, however, can be left for future consideration. It will suffice here to say that if such an organ does exist, though imperceptible to the anatomist, and if the brain is its instrument of activity, the above-named cerebral phenomena would be as necessary as on the brain-mind theory.

The earliest effort to definitely deal with this question is that of Cabanis, who advanced the idea that the brain acts like a gland, and secretes thought. This idea made a decided ripple in the thinking world, though it has long since died out. Maudsley's idea is that every sensory impression upon the brain leaves behind it some modification of the nerve elements. This he considers to be the physical basis of memory. He looks on the change that takes place as a motion, which he considers analogous to the "compounds, and compounds of compounds, of vibrations in music." Other authors propound like views, and consider thought to be a persistent vibration of the nerve fibers of the brain. Luys offers the same idea in a fuller shape. He says: "I have proposed to apply the term *phosphorescence* to that curious property the nerve elements possess of remaining a longer or shorter time in the state of vibration into which they have been thrown by the arrival of external excitations; as we see phosphorescent substances illuminated by solar rays continue to shine after the source of light which has illuminated them has disappeared."

This is the present state of the brain-mind theory, as advanced by its most ardent and learned advocates. The only definite conclusion to which they can arrive is, that thought is a persistent vibration of the cerebral nerve fibers. Indeed there is no other theory open to them. The discoveries of late years hinder them from taking refuge in the powers of a brain cell of unknown organization. It has become evident that the brain cell is essentially a mass of very delicate fibrillæ which are continued through the nucleus, and in all probability are continuous with the nerve fibers. Thus we have nothing but fibers of greater or less minuteness to deal with, and it seems to follow as a necessary

consequence that if thought is nerve motion it must be some motion of elongated fibers. This motion enters the brain as a mode of vibration in these fibers, and we can conceive of its persistence in or on them in no way except as a vibration.

Yet to theorize about a persistent vibration is to theorize on the impossible, and to set aside all the results of the science of acoustics. There is no such thing in nature as a vibration persistently active in a limited region. No limited chord can vibrate unceasingly. Its vibrations must be rapidly transmitted to the surrounding material, or be converted into some other mode of motion. Otherwise the chord would have to be surrounded by a perfect vacuum, and be utterly free from friction. No such conditions exist in the brain fibrillæ. Thus a vibratory nerve current, even if transferred by induction to a closed cerebral circuit, could not possibly retain its original condition. It must make its way onward, be transferred to surrounding material, or be quickly transformed into some other mode of motion. The conditions of the mental organism require that this mode of motion shall be an organizing one, a persistent motor affection of some substance. The brain fibrillæ, which are essentially continuations of the nerve fibers, cannot constitute such a definite and self-centered organism. Neither can the cell substance surrounding these fibrillæ. It is to this granular or homogeneous protoplasm seemingly that the cerebral activity is due. The motor impulses conveyed inward by the fibers appear to instigate chemical changes in this substance precisely as they do in the muscle substance. It falls into a lower stage of integration and sets free the energies which arouse the mind to action. Thus the brain cells seem solely instruments of the mind. But for them the mind would remain dormant. They yield, under the influence of external impulses or of impulses derived from the mind itself, energies which call the mental organism into activity. But this very evident characteristic, and the constant cerebral changes which it occasions, strongly indicate that the mental organism is distinct from the cerebrum, though to all appearance very intimately connected with it.

It may seem absurd to speak of the existence of an organism thus related to the cerebrum yet not evident to our senses. Yet the more we consider the brain as the organ of mind the less does it seem adapted to the duties thus imputed to it. It has of late

been rendered almost certain, by the researches of Ferrier and others, that each region of the cerebrum has its special duties, to the performance of which it is strictly confined. Here sensation seems to center; there motor impulses arise. Into this locality flow the sensations of sight; into that locality those of taste or smell. Speech has its center here; the motion of a particular muscle there. Instead of the whole brain being concerned in every action, each limited portion seems to be immediately and strictly related to some fixed sensory or motor region. The evidences of this are as yet somewhat broad and general, yet they are steadily growing more precise and particular. Every nerve fiber proceeding from a sensory end organ or a group of muscle fibers may connect directly with a special group of brain cells, and possibly every fibril of these fibers may terminate in a single brain cell at one extremity, and in a single muscular fibril or sensory point at the other. If such were the case the brain would be closely related in condition with the outer terminations of the nerves, and the nervous system would consist of a vast series of fibers diverging outwardly to terminate in a widely separated series of sensory and muscular cells and fibrils, and converging inwardly to terminate in a closely aggregated series of nerve cells, the latter being as individual in their duties as the former, despite their much closer grouping.

This, of course, is purely hypothetical, yet the special relation of groups of brain cells to groups of sensory or muscle cells or fibers has been established by experiment, and it is not safe to limit the possible minuteness of this relation. Yet the existence of such a relation seems to stamp the brain as the instrument of an interior mental organism. In the operations of the mind there is no evidence of such a disconnected series of duties. The mind constantly impresses us as an intimate unity. Its thoughts are in continual rapport, and call up each other with instantaneous rapidity. Such a relation could not well exist between the imagined localized vibratory energies of the brain. If each locality were capable of sending its vibrations at will to any other locality, and rousing into activity the energies of distant regions, what is to hinder the complete dissemination of these energies? If such a condition existed, the fibrils of every cell in the brain must soon become affected with a vast multitude of diverse and frequently discordant pulsations. And it is impossible to imagine

how such pulsations, even if their continued local existence were possible, are to be thus restrained and confined. They are capable at intervals of flowing out upon the fibers of the motor nerves. What hinders them from immediately flowing out? By what power are they retained, so as to be let off at arbitrary and far separated intervals? And when once such vibratory energies are set free upon the motor nerves how can they still exist in the brain? Thought is persistent, yet on this theory it could only be persistent if it never produced any effect. Motion cannot be increased or diminished at will. It cannot be discharged and yet retained. It cannot become an outflowing radiation while still existing with undiminished vigor as an organizing agent.

The problem of consciousness comes into the question here. If thought be a persistent motor affection of the nerve fibrils, and if consciousness is an accompaniment of all active thought, why then are we not steadily conscious of all our thoughts? Are we to look upon consciousness as a separate traveling agency, which moves irregularly from part to part of the brain, and adds a new increment of activity to every thought with which it momentarily combines? We can in no other way explain the vagaries of consciousness on the brain-mind hypothesis.

Again, if the brain is the organ of the mind, one of two things must be true. Either every brain cell must contain a special portion of the mental energies, or, if the thought vibrations can make their way everywhere through the brain, every cell must be a miniature copy of the whole mind. The localization of the powers of the brain is an argument for the former. The close interrelation of thought seems to necessitate the latter. The dilemma of the brain-mind theorists has its two horns of difficulty, and it becomes incumbent upon them to harmonize these opposed conditions. Another difficulty connects itself with the preceding. This is, that the cerebral cells are not permanently in existence. Every action is attended by cell waste. The old cells die and new ones take their place. Or new ones arise by the process of cell division. If the cells are reservoirs of special motor forces, what becomes of these? Are they transmitted hereditarily to the new cells? This can hardly be, since the death of the old cell is often a consequence of the transmission of its special energy to motor nerves. It cannot, therefore, transmit more than its general organizing energy to new cells. The

germ cell of an animal exists as a remarkable counterpart of the general energies of its parent, and the offspring develops into a close copy of the parental physical characteristics and mental conditions. Yet the special knowledge of the parent is never transmitted to the child. Unless the latter gain special knowledge of its own, it will remain in this respect undeveloped. So one cell may transmit to its successor its organizing characteristics, but scarcely its more delicate special motor conditions.

In fact, the more we consider this hypothesis the more unsatisfactory does it appear. If the brain is to be looked upon as a material organism, a machine with thought for one of its products, we might naturally expect to find some analogy to its mode of action in other machines. It is credited with a double duty. It is a receiver and dispatcher of nervous impressions, and it has a special discriminating power as to how, when and whither it shall despatch these impressions. What is there in the brain to decide which impressions shall be retained and which transmitted? Are there special resistances in some cells of the brain which hinder the transmission of sensory impressions to the muscles? If so, how come these resistances to break down at such arbitrary periods. What principle makes some cells resisting and others non-resisting? How is it, again, after this resistance has yielded, and the motor energy flowed out to the muscles, that the thought which it represents is still found intact in the mind, and usually stronger than before? What machine is it that has its energy within itself and still possesses it after using it to set a train of wheels in motion? And finally, how do we explain the peculiar relations of consciousness to these thought impressions?

All this presents no difficulty if we can conceive of a mental organism distinct from, but in the most intimate relation with, the cerebrum, upon whose separate regions its thoughts play, like the fingers of a performer upon the separate keys of a piano. The same finger may touch many keys in succession and bring out a special tone from each. The player may be a single organism, a resultant of organizing motor energies inherent in a definite mass of substance, while the instrument may be made up of many separate parts, having only general and no intimate interrelations. The player may bring out what sound he desires, but it would not be easy for one key to emit another sound at will, or to force another key to emit its special sound. And even if the piano

key had a reservoir of energy by which, at some arbitrary period, it could suddenly spring into activity and yield a peculiar sound, evidently a part or the whole of this special force must be exhausted in doing so. But if struck by an exterior organism the latter might be strengthened by the exercise, as a muscle is strengthened by use. This is a characteristic feature of mental action. Its special energies, or its thoughts, are strengthened by use. It seems evident that such a condition can only exist in the case of a definitely centralized organism, affected by motion as an organizing agent, and also by generalized motions, which it has the power to divert in certain directions without detriment to its organization. Such is the human body. It is definitely organized by the double agency of chemical affinity and inhering motions, which limit the condensing action of affinity. In addition it is the seat of heat, electric and other motions, which it can employ as agents of external action. The mind, as an organism, displays these same characteristics. It is organized by permanent motor conditions. It receives and emits definitely directed motions. And its organization is affected and developed through this activity precisely as the organization of the body is aided and modified by the energies which it receives and emits. The parallel is a close one, and indicates that the mind, like every organism in nature, is a self-centered mass of substance, held together by affinity and organized by inherent motions.

There is nothing in the conditions of the cerebral organ to indicate that it is such a single, definite organism, or that it is capable of manifesting the peculiar phenomena of the mind. The great difficulty in the brain-mind theory is that the machine cannot contain within itself the voluntary will power of the engineer. If thoughts are the motor energies of the brain matter it is simply incredible that they could arbitrarily retire from and reënter the field of activity. The character of their activity must be fixed, constant and unvarying. And the effects they are capable of producing must be immediately or incessantly produced. It is impossible to conceive of a self-acting machine under any other relations. All its energies must be steadily in activity, and its effects on outer matter must be limited and constantly similar. We cannot imagine such a machine arbitrarily changing its action; now producing one effect, now another; now acting on

one substance, now on another; its different parts irregularly rising into activity or sinking into quiescence; and its energies continuing unchanged and inexhausted through all this varied outflow of motor activity. No instance of the kind was ever seen or can be imagined to exist. The existence of such arbitrary and seemingly voluntary activity irresistibly leads to the inference of a separate agent overruling the action of the machine, and now calling this, now that part into activity. On the theory of self-action of any instrument it is impossible to admit the existence of arbitrary and irregular variations of activity like those of the mind. On the opposite theory that the mind is an organism separate from the brain, and using the latter as its instrument, we can readily comprehend the varying action of the instrument. If the two be in close but not in constant connection; if the mind now makes contact with one group of brain cells, now with another, and now withdraws from all contact, the difficulty diminishes. Why these varying contacts takes place is a question of a different character. They may be due to influences of affinity or polarization, which are subject to change under the changes in cerebral conditions which they induce. Or they may be otherwise produced. It is difficult to understand the cause of such seemingly arbitrary contacts; but this difficulty is not an impossibility like that attending the brain-mind theory. And under the idea that the mind is a separate organism we can understand the vagaries of consciousness, which cannot possibly be done under the brain-mind hypothesis. This subject will be considered later.

There is one more consideration to which we may briefly advert. The cerebrum is subject to pathological changes. It frequently becomes incapable of doing its duty properly. In many instances of cerebral disorder the mind seems to disappear. A whole series of mental conditions may utterly vanish, and remain lost for years. A new series of mental conditions may be built up. Or every trace of intelligence and consciousness may disappear and the body act as a mere automaton, governed by reflex action only, or possibly by the deeply based hereditary or instinctive mental powers. And yet, after years of this mental obliteration, there are instances on record where the brain recovered its normal condition and the mind reappeared with all its former contents of memories, opinions and ideas. Such a cir-

cumstance it is impossible to comprehend under the theory that the thoughts are but motor affections of brain matter. In these years of disorder it is absolutely certain that considerable modifications must take place in this matter. The motions affecting its cells and fibers cannot continue absolutely the same as they were years before, but must have become greatly changed and reorganized under years of influx of external energies. But if we view the mental organism as separate from the cerebrum these strange phenomena lose much of their mysteriousness. In that case the disorder of the cerebrum may not have directly affected the mind, but simply broken the connection between the mind and its organ of manifestation and development. The mental organism may lie for years intact, as a crystal lies buried in its bed of rock. It retains its original conditions since it has been removed from the influence of disturbing energies. And when once again it regains its powers of manifestation, through the regained normal condition of the cerebrum, it must reappear in the precise condition which it had attained at the period of the broken connection, and with all its memories and ideas intact.

If we consider the relations of the nervous system from this point of view, we perceive it to be composed of a vast aggregate of fibers, which divide into their constituent fibrillæ in the ganglion cells. These fibers are in contact, at their opposite extremities, with two distinct sources of energy. One series of them runs from the brain to the sense organs on the surface. Another series runs from the brain to the muscles. The first series has its receptive extremities at the surface, and conveys the energies of external nature to the brain to discharge them into the mental organism. The second series has its receptive extremities in the brain, and conveys energies received from the mental organism to the muscles, there to discharge them. Each of these fibers apparently has its fixed and single duty. If one of the sensory nerves be touched, it carries an impression to a fixed locality in the brain. If one of the motor nerves be touched, it carries an impression to a fixed muscle. The more deeply anatomy and physiology search into the conditions of the nervous system the more clearly it appears to be simply such an instrument for the conveyance of impressions to and from two sources of energy, an external and an internal one, and the less fitted does it seem to sustain the theory that the brain is the organ of the mind.

THE EXHALATION OF OZONE BY ODOROUS PLANTS.

BY DRS. J. M. ANDERS AND G. B. M. MILLER.

IN the AMERICAN NATURALIST for April and May of the year 1884, there appeared two articles, by one of us, treating of the "Exhalation of Ozone by Flowering Plants." The reader will there find recorded the results of numerous experiments which were made with the view of ascertaining whether or not plants have the power to generate ozone. The chief conclusions therefrom deduced were as follows: 1. That flowering plants in general are capable of generating ozone, and odoriferous flowers in particular. 2. That foliage plants do not possess this function.

It should be remarked that the present re-investigation of the subject was undertaken with the view either of confirming or disproving the correctness of the above conclusions. Owing to the high importance of the question of the relation of plant growth to the generation of ozone, this course was deemed almost incumbent.

As the more important properties of ozone were discussed in the previous papers, it is not deemed necessary to do so here. The hygienic relations of this substance also received brief attention while its tests received careful consideration; hence to further enlarge upon these phases of our subject, at present writing, would be a work of supererogation. The methods employed in the former experiments were likewise used in the present series. The following apparatus was used: A glass case large enough to contain a dozen or more thrifty growing plants in pots. Its dimensions were, length three and a half feet, width two and a half feet, and height two and a half feet. A portion of the top was left removable, so as to furnish an aperture through which the plants could be placed in the case and again taken out. The tests employed were the Schoenbein paper and paper impregnated with tincture of guaiacum. When exposed to ozone artificially prepared the Schoenbein paper turns quite blue, while the guaiacum paper first turns greenish-blue and finally a bright blue. In the present experiments we also employed the same terminology, viz., "marked," "slight" and "very slight," to denote the degree of blue coloration.

A dozen thrifty plants belonging to the species *Coleus blumei*,

not blooming, were first selected and placed within the glass case. The test papers were moistened and suspended on the branches of the plants. After adjusting the removable part of our case, the latter was found to be pretty well filled though not overstocked with plants. For the purpose of detecting any alkaline substance whose presence, it is said, will change the Schoenbein and guaiacum papers in a manner indistinguishable from that produced by ozone, we suspended with the test papers a piece of red litmus, with the results indicated in the following tables. The air on the exterior of the case was simultaneously tested for ozone. In view of the fact that these tests are in an unsatisfactory state, the necessity for taking precautions against interfering conditions must be obvious to the mind of the scientfic reader.

The following table will serve to show the results obtained from the specimens above named for seven consecutive days in the month of June, 1884:

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Time.*	*State of weather.*	*Litmus (red).*
No. I.....	negative	negative	negative	8 hours	clear	negative
No. II.....	"	"	———	8 "	"	"
No. III.....	slight	marked	marked	11 "	"	blue
No. IV.....	negative	slight	negative	9 "	"	negative
No. V.....	"	very slight	marked	9 "	"	"
No. VI.....	"	"	negative	10 "	"	"
No. VII.....	slight	marked	slight	8 "	"	blue

These results are in exact accord with those previously recorded (supra) by one of us. It should be remarked that whilst two "slight" reactions occurred with the Schoenbein paper, they were probably due to the presence of some alkaline substance, since on the same days the red litmus was changed to a "marked" blue. Thus, after repeated experiments, it would appear certain that it cannot be claimed for non-odorous foliage plants that they are ozone-generating. Though the guaiacum paper gave "slight" reactions in three experiments which yielded no results with the litmus paper, it should be here noted that owing to the fact that this paper (guaiacum) is materially affected by various atmospheric conditions, we did not much rely upon the results obtained from its employ. On the other hand, if proper precautionary measures be taken, the Schoenbein is, doubtless, of all the tests for ozone the most reliable.

We next experimented with odorless flowering plants, selecting ten plants of the species *Fuchsia globosa* and ten periwinkles, species *Vinca rosea*, with the following results:

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Litmus (red).*	*Time.*	*State of weather.*
No. I.....	marked	marked	negative	negative	10 hours	clear
No. II.....	negative	"	marked	"	9 "	"
No. III.....	"	negative	negative	"	10 "	"
No. IV.....	very slight	slight	slight	"	13 "	"
No. V.....	"	negative	"	"	9 "	"
No. VI.....	"	slight	marked	"	9 "	"
No. VII.....	negative	"	"	"	10 "	"

During these observations, which were made in the month of July, 1884, the temperature within the case ranged from 80 to 100° Fahr. It will be observed that sufficient ozone was generated in four of the experiments to give one "marked" and three "very slight" reactions; also that the litmus gave no indications of the presence of ammonia. Although they do not rank as active ozone-generators, nevertheless they must, from the facts of the case, be looked upon as sharing this important function in a slight degree. This decision also coincides with what had been previously demonstrated by experiment.

We now made a trial of odorous flowering plants, selecting for this purpose seven roses and seven specimens of *Lilium longiflorum*. After carefully enclosing them within the case, the atmosphere of the latter was tested and simultaneously the air outside, with striking results as shown by the following table:

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Litmus (red).*	*Time.*	*State of weather.*
No. I.....	negative	marked	negative	blue	8 hours	clear
No. II.....	marked	"	"	negative	9 "	"
No. III.....	negative	negative	"	"	9 "	pa'ly clou'y
No. IV.....	slight	marked	marked	"	8 "	clear
No. V.....	marked	"	slight	"	10 "	"
No. VI.....	"	"	very slight	"	10 "	"
No. VII.....	"	"	"	"	11 "	"
No. VIII.....	"	"	negative	"	10½ "	"

During these experiments the temperature of the air in the case ranged from 80 to 100° Fahr. The important conclusion arrived at in previous papers,[1] viz., that odorous flowering plants are active and energetic ozone-producers, it will be clear, receives from present researches entire confirmation. Since this

[1] Dr. Anders on "Exhalation of Ozone by Flowering Plants," *loc. cit.*, p. 474.

function is so actively carried on by odorous flowers, it occurred to us to make a trial of plants whose leaves emit odors but having no flowers. Blooming geraniums having been experimented with while making previous researches into the same subject, and having found them to be capable of generating ozone, it was determined to employ a number of specimens belonging to the genus Pelargonium not in bloom, with a view of ascertaining whether the reactions obtained with flowering geraniums were due to the presence of the flowers, or whether they were due in part to the odorous principles emitted from the leaves of the plants. To our astonishment slight reactions were obtained, as shown by the following record of results:

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Litmus (red).*	*Time.*	*State of weather.*
No. I	very slight	slight	marked	negative	10 hours	clear
No. II.....	negative	negative	"	"	10 "	"
No. III.....	"	"	"	"	10 "	"
No. IV	"	"	negative	"	10 "	rainy
No. V.....	very slight	very slight	"	"	10 "	clear
No. VI	negative	slight	"	"	9 "	"
No. VII.....	very slight	"	marked	"	9 "	pa'ly clou'y
No. VIII.....	negative	negative	negative	"	10 "	rainy
No. IX	"	marked	marked	"	11 "	clear
No. X.....	marked	slight	slight	"	10 "	"
No. XI	slight	"	negative	"	9 "	cloudy
No. XII.....	negative	negative	"	"	10 "	rainy

Although there were but three "very slight" reactions, one "slight" and one "marked" with the Schoenbein obtained in the twelve experiments here recorded; this is not a bad showing when it is recollected that four of the tests giving no indication of ozone were made on rainy days, it having been shown in the former investigations that sunlight or at least good diffused light is an essential condition to the generation of ozone by plants.

Upon this point, however, the evidence afforded by the results of the present set of experiments alone is too slender on which to base positive conclusions, and hence we deemed it desirable to make further observations upon foliage possessed with marked perfume. To aid in clearing up this subject it was next resolved to make tests with pine foliage, possessing the well-known terebinthinate odor, and in the results obtained we were not disappointed.

Seven branches taken from the species *Pinus strobus* were introduced into the case in the upright position, when the same

tests were applied as in the experiments on growing plants, with results as follows :

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Litmus (red).*	*Time.*	*State of weather.*
No. I	marked	slight	very slight	negative	9 hours	clear
No. II.....	"	marked	slight	"	10 "	"
No. III.....	"	"	"	"	9 "	"
No. IV	slight	slight	marked	"	10 "	"
No. V.....	negative	negative	"	"	9 "	"

After three days the pine branches turned brown and the leaves rapidly dropped off. These facts doubtless account for negative results after the fourth day. It should be stated that we continued to test them on the sixth and seventh days respectively, and with negative results in both of the latter instances. We were, however, encouraged by the success attending the first three experiments, and resolved to make another trial of pine branches. Accordingly we again selected a half dozen pine branches which moderately filled our little floral chamber, and allowed them to remain only until they began to show a change in color, which change was first observed at the end of the third experiment.

The following results speak for themselves :

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Litmus (red).*	*Time.*	*State of weather.*
No. I	marked	marked	marked	negative	9 hours	clear
No. II.....	"	slight	negative	"	10 "	clear, partly cloudy
No. III.....	"	"	slight	"	10 "	clear

We also made four daily experiments with branches taken from the Norway spruce (*Abies canadensis*) and, as shown by the following record, with happy results :

No. experiment.	*Schoenbein.*	*Guaiacum.*	*Schoenbein in open air.*	*Litmus (red).*	*Time.*	*State of weather.*
No. I	marked	marked	slight	negative	12 hours	clear
No. II.....	"	slight	negative	"	10 "	"
No. III.....	slight	marked	"	"	10 "	"
No. IV	marked	slight	marked	"	9 "	"

We, unfortunately, were unable at that time to obtain more foliage of the same character, and thus our investigations were brought to an end. Although a greater number of experiments upon this point could have been desired, when, on the one hand, it is recollected how great and numerous the difficulties connected

with the making of such tests, and on the other, the brilliant and very uniform success of the experiments made with pine foliage, it will be readily conceded that these facts furnish abundant evidence of the power the odorous principles evolved from the pine tree have to generate ozone.

From the foregoing, in conjunction with former investigations into the same subject, we are, at present writing, justified in formulating the following conclusions:

First. That flowering plants, including odorous and inodorous, generate ozone, the former, however, much more actively than the latter.

Secondly. That so far as tested scented foliage does possess the power to produce ozone, and. in the case of pine or hemlock foliage in a marked degree.

Thirdly. That inasmuch as no reactions occurred on rainy days, it is highly probable that the function demands the influence of the sun's rays or at least good diffused light.

In comparing the present with former conclusions, cited at the commencement of the paper, it will be seen that they differ in so far as relates to foliage plants only, those pertaining to flowering vegetation being perfectly concordant.

As to the mode in which the ozone is developed by plant life, or in other words, as to what is the nature of this ozone-generating function, the following explanation was elsewhere merely suggested (loc cit.): "It is known that the ashes of seeds contains large quantities of the phosphates. It follows that during the formation of the seed there is a rapid metastasis of the phosphorus in the form of phosphoric acid, and the phosphates to that organ of the plant, and it may reasonably be supposed that in the chemico-vital interchanges going on in the ovules, phosphorus is liberated and acted on by the moisture which the leaves are so actively transpiring. * * * The subject, however, merits further investigation." In view of the facts established by present researches the theory of the production of ozone by vegetable growth above cited must be abandoned, and it appears evident, from present premises, that in some way the odoriferous principles emitted, whether from flower or foliage, are chiefly concerned in its formation. It is true we are unable in this manner to account for its production by odorless flowers, unless, as many contend, we grant that all blossoms are either

bedecked with or, somewhere in their loose cellular tissue, contain scented nectar which in many so-called inodorous flowers may not be sufficiently pronounced to be perceived by the organ of smell.

It is a well-established fact that wherever fertilization is accomplished by insects, so-called *nectaries* are somewhere found in the flowers. These organs are described by Sachs as follows: "The nectaries are often nothing but glandular portions of tissue on the foliar or axial parts of the flower; very often they project in the form of cushions of more delicate tissue or take the form of stalked or sessile protuberances; or whole foliar structures of the perianth, of the androecium or even of the gynœcium, are transformed into peculiar structures for the secretion and accumulation of the nectar."[1]

The proportion of plants where pollination is effected by insects is certainly large, and when we take into account those flowers in which cross-fertilization occasionally results from the aid of insects, this proportion is still very much larger. Whether it can be claimed for all inodorous flowers that they contain a greater or lesser number of nectaries we are not prepared to state, but it is certain that numerous flowers, which are classed as being without fragrance or any other odors, such as the geranium, the passion flower, etc., are visited by insects, and these must therefore contain glandular tissues filled with an alluring secretion. The question also naturally here arises: Are there not flowers that are never visited by insects, which flowers possess these glandular organs?

Our investigations did not include an examination of these organs, but there is evidently an interesting subject here presented for further experimental study.

The theory that the fragrant emanations from flowers, as well as all the various odoriferous substances emitted from plants, stand in close relation to the ozone-producing function in plants likewise receives striking corroboration in the well-known chemical fact that the volatile perfumes and the strongly-scented aromatic substances have the power to convert the oxygen of the atmosphere into ozone.

The application of the results of our experiments to the rather old but highly interesting subject of the cultivation of house plants

[1] Sachs' Text-book of Botany, p. 500.

is of considerable importance. That phase of the question, however, pertaining to flowering plants has been elsewhere treated. It remains to speak of the sanitary relations of the new and additional fact which has been established by the present experiments concerning odorous leaves as ozone-generators. Owing to the fact that few varieties which have markedly odorous leaves are cultivated within doors, their sanitary bearings may be regarded as being slight, the leaves of the geranium and other species usually seen in dwellings being feeble in their ozone-generating properties. Again, it should be remarked that when kept indoors the odors given off both from the flower and foliage are sometimes not only objectionable to the senses, but also may prove detrimental. It is evident that such plants should be discarded.

The case is widely different when we apply the results of our labors to the question of the hygienic value of out-door vegetation, and more particularly of pine groves. Under these circumstances unpleasant odors do not form a positive objection, whilst the species emitting the most pronounced odors are capable of rendering valuable hygienic service by furnishing ozone to the surrounding medium. Since the exhalations from the pine foliage are active agents in generating ozone, it follows that all of the important hygienic advantages of ozone are to be derived, to a marked degree, from the presence of pine woods.[1]

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GLACIAL ORIGIN OF PRESQUE ISLE, LAKE ERIE.

BY T. DWIGHT INGERSOLL.

THE peninsula of Presque isle is an extension of the main land opposite the city of Erie, Pennsylvania, reaching out into Lake Erie in a north-eastern direction. It is crescentic in form, the convex portion facing the lake with the shore line bending toward the mainland, and forming Erie harbor, which is known also as Presque Isle bay. The bay is about four miles in length by about two in breadth, with an entrance on the east. Government operations have made the bay somewhat historical, The vessels of Commodore Perry's fleet were built here in 1813,

[1] For a fuller discussion of the subject of the sanitary relations of pine forests, see article by J. M. Anders, on "Sanitary Influence of Forest Growth," a paper read before Phila. Co. Med. Society, Oct. 22, 1884.

and after his victorious battle the *Lawrence* and flag-ship *Niagara* lay in the bay until the centennial year, 1876, in front of the old block-house on Garrison hill, where General Anthony Wayne died and was buried in 1796.

When the peninsula was first occupied by Government soldiers it was several feet broad at the junction with the mainland and covered with large forest trees, but the constant action of waves, since that time, has reduced that portion to a narrow neck of land over which the waves have, during the past year, rolled into Presque Isle bay. There is a strong probability that before the expiration of the year this tract of land will be transformed into a traveling island en route to Niagara falls, unless something is done to protect it from lake storms. For a consideration of this matter there was a meeting of the Erie Board of Trade on January 5, 1885, at which Ex-judge John P. Vincent said:

"Since I came to Erie, in 1839, the north arm of the peninsula has moved several rods, and the east end extends fully a mile further than it did then. If something be not done the peninsula will waste away at the head and build up at the foot, and eventually the harbor will be below the city."

Engineers, however, have estimated the increase of land at the lower end to average only thirteen feet per annum. All this material—sand and pebbles—has been washed from the north shore, principally from that portion near the head, and when it reached the foot an eddy was formed around it, the sand falling to the bottom and becoming new-made land. Sometimes this material was carried past the peninsula too far for a union with the foot, and a bar and perhaps an island was formed, against which other sands lodged. At some subsequent time we may suppose that the eastern portion of the new formation was broken up by opposing easterly gales, and the sand carried along both sides of the new island toward the west until a union was formed with the peninsula, shutting in between the two connecting bars of sand a pond of water, and the island thereby became the foot of the peninsula, receiving further increase. In this way it is supposed that several fish-ponds, now in existence on the peninsula, have been formed.

From the briefly sketched history of Presque isle the reader may naturally be led to inquire into its origin. The writer at one time imagined that there might have been a small uplift of rocks under the surface such as he had seen on the mainland in the

vicinity; but after a personal investigation and inquiry of civil engineers, he came to the conclusion that the land is composed entirely of sand, clay and rolled pebbles of foreign and native rocks.

History shows that this material has not only been changeable in form, but small quantities have from time to time been transported from the western to the eastern portion by the waves. These changes must have been in progress prior to its discovery, and of course the peninsula was situated further west than it is now. This we may regard as a clue to the origin of the peninsula however hypothetical it may seem to be. The material being almost identical with glacial drift that is scattered all over Northwestern Pennsylvania, which in some places is nearly 200 feet in depth, and may have had the same origin, having been deposited at the same time about twenty miles west of its present site, where the Devonian strata dip gently under the surface of the lake. At that point a vast quantity of glacial drift was shoved upon the sloping rocks during the ice age, and that deposit has been the sport of the waves ever since the retreat of the great northern glacier. Professor I. C. White, of the Pennsylvania State Geological Survey, says:

"The varied character of the northern drift deposits can be well studied along the shore of Lake Erie, towards the Ohio State line, where they constitute a terrace bluff from fifty to eighty feet high, out of which the waves are constantly removing the clay and fine sand into the lake leaving the coarse sand, pebbles and boulders to be daily rounded and polished on the beach."

At the close of the ice age the waves began to wash away the finer particles from the bluff of drift, and as the current of the water was down the lake in a north-eastern direction—the storms moving generally the same way—the probability is that a bar of sand was formed at some favorable place east of the starting point, upon which other material was driven year after year until an island or peninsula was formed. At some later period more powerful storms broke up the western portion and carried it along to or beyond the eastern extremity, while it was being constantly enlarged by sand from the original source, and from the bluffs and watershed along the shore, which was brought down by numerous streams. In this way let us imagine the bar became an island or a peninsula, and alternating perhaps with each other until the erratic bodies of land appeared to the first white settlers of this region in form of a peninsula.

ERIE, PA., AUGUST, 1885.

RECENT LITERATURE.

PRINCE ROLAND BONAPARTE'S LES HABITANTS DE SURINAME.[1] —The contents of this luxurious and costly volume will prove highly interesting not to the ethnologist only, for it far exceeds the scope of his special line of research, but to the general public as well. The types of humanity which were exposed to public view at the Amsterdam Colonial Exhibition portrayed so faithfully a portion of the Dutch Guiana population that a partial study of these was rendered feasible in spite of the enormous distance separating them from their native country. The mode of anthropologic investigation followed by the Prince is sketched by him in concise language in the preface, and his methods for gaining an insight into the habits, customs, institutions and languages of a people are detailed at length. He divides that country into three dissimilar geographic belts: the coast marsh, the savanna and the primeval forest of the interior. The history of Guiana colonization is first passed in review; the main part of the volume then opens with a sketch of the Indian population, with another of the sylvan Negro, and another of the sedentary Negro, the whole profusely illustrated by full-face and profile photo-engravings of the human subjects exhibited at Amsterdam. Colored plates illustrating various manufactures and divers objects of interest for the study of these populations are added. The book divides *the Indians* into three sections: the Kalina or Carib, the Warrau and the 'Arowak. Though in contact with Europeans for longer than a century, they have retained many of their aboriginal characteristics. No Indian of the *wild* interior tribes had been brought to the Amsterdam exhibition, and hence these were omitted from the description in detail. The coast Indians do not count over 800 individuals now; they assimilate with difficulty and tend to disappear under the funest influence of firewater and disease. The chapter following this deals with customs, habits and beliefs of the Indians, and entirely rests on personal or otherwise trustworthy information. The singular custom of the couvade or male childbed is alluded to at length and an explanation offered. Heretofore our information upon the large class of runaway slaves ("nègres marrons"), or descendants of such, was very limited, but here new points are presented in logical order and profusion. These escaped "Negroes of the bush" who, for more than a century back in time, settled along the large rivers descending from the interior, and exulting in their newly-gained freedom, often made raids upon the plantations, are first alluded to in the pages of the "Lettres Edifiantes." It appears that there are now about 8000 of them, divided locally

[1] *Les Habitants de Suriname. Notes recuillies à l'Exposition coloniale d'Amsterdam en 1883.* Paris, imprimiere de Quentin, 1884. Gr. fol. 227 pp., 2 cartes et 72 planches.

into Aucaners, Bekoes, Moesingas, Saramacanan and Bonis. Their peculiar beliefs and customs, upon which the Prince's volume expatiates at length, are clearly of African origin and extremely curious. Besides the *takitaki* or Negro-English jargon of Suriname (from "*talkie-talkie*"), each local sept uses special terms of African origin, and the majority also converse in the native African tongue. The *sedentary Negroes* subdivide into plantation Negroes and city Negroes, these latter forming forty-seven per cent of the whole colonial population. Specimens of the takitaki jargon are appended.

A sequel to this instructive volume is announced by the author himself, and we wish it may be presented to the studious public at an early day.—*A. Pinart.*

BERGEN'S DEVELOPMENT THEORY.[1]—This little book is designed to present to the ordinary reader a brief summary of the evolution theory. The task is fairly well done, as the facts and theory are set forth in an attractive way, and from a varied and wide point of view.

It is just the sort of book one would give to a boy or girl, a farmer or mechanic who wanted to know what evolution means, and perhaps older people and those who have graduated from our colleges a generation ago before the doctrine became a part of ordinary scientific teaching, will find in its pages just the sort of information they want.

The facts are correctly stated, and so are the inferences. We think, however, known facts do not support the enormous antiquity ascribed to man, viz., "over two and a half million years." We think these figures are beyond those of the "best authorities." It is better in books intended for popular use to give under rather than over statements. Also the ape-like characters of the Neanderthal skull are perhaps over stated. As we understand it, Wyman found quite as brutish a skull in the Indian mounds of Florida. The evidence has yet to be afforded that the earliest known race of man in Europe was any lower than the lowest existing savages. Such evidence, may however, be forthcoming any day.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Asia.—*The Badghis district.*—This district in Northern Afghanistan, north of the watershed of the Herat valley, consists of hills and valleys of sandstone clay, the hills rising from 200 to 600 feet, or even to 1000 feet, between two great streams. Though sand-covered and desert-looking in autumn, they are not only cultivable on their lesser slopes but exceedingly fertile, and in spring are covered with flowers and grass knee-deep. The northern and western parts have little running water, but the eastern and southern portions, along the Parapomisus and the Kushk rivers, are exceptionally fertile. Sir Hy. Rawlinson states that the Bundehesh, a work compiled before the Arab conquest (in the fourth or fifth century) derives "Badghis" from the tribe of the Vad-Keshan or "wind-worshipers." Coins of the Kushan or Tokhari show that these tribes did worship the wind. They were commonly called "White Huns," came into the land in the fourth or fifth century, and had for their capital, Talikan, thirty or forty miles east of Maruchak. Badghis (Kileh-Maur) was their strong place.

The Pescadores—The Pescadores, recently bombarded and occupied by Admiral Courbet, are in the Formosa channel, about twenty-five miles from Formosa. The largest is Panghu, and the Chinese name for the group is Panghuting or the Panghu district. Panghu is forty-eight miles in circumference, and the next in size, Fisher's or West island, is seventeen. The population of the two larger islands was given by Admiral Collinson, in 1845, as 5000, that of all the islands, 8000. There are twenty-one inhabited islands besides several rocks. Trees are

[1] This department is edited by W. N. Lockington, Philadelphia.

wanting, millet and the ground-nut are grown, and in the sheltered spots the sweet potato, but the natives depend mainly on Formosa for vegetables and fruits. The islands offer shelter in all states of the weather in the dangerous Formosa channel.

Port Hamilton.—Port Hamilton was stated, by *Nature*, to be identical with the large Corean island of Quelpart, about sixty miles due south of the extreme point of Corea. It is 150 miles from Shanghai and 100 from Nagasaki, and lies in the mouth of the only exit to the south from the Sea of Japan. It is an oval rock-bound island covered with innumerable conical mountains, often topped by abrupt volcanic craters, the highest of which, Haura, or Mt. Auckland, is 6500 feet high, and bears at its summit three craters, within each of which is a lake of pure water. Corean children are taught to believe that the three first-created men still dwell in these lofty heights. The island is well cultivated, and contains three walled cities and several towns, but has no good harbors. It has long been a place of banishment for criminals. The chief manufacture is that of straw hats, which are the best in Corea. Iron appears to abound on the southern coast.

Nature and other English papers were, however, mistaken in the statement that the large island of Quelpart is identical with Port Hamilton, which is marked upon German maps as situated somewhat to the north of Quelpart, and is formed by three rocky and elevated islets.

Asiatic Notes.—The name Pamir applies generally to the whole region lying at the sources of the Amu-daria. The word is derived from *bam*, roof, and perhaps the Kirghiz *ir*, earth. It extends in the shape of a horse-shoe from north to south 200 miles, and from east to west 170 miles. This area of 67,000 square versts has been surveyed on a scale of five versts to the inch. On the north and south its limits are well marked by the Alai and Hindu-Kush ranges respectively, while its eastern boundary is clearly defined by the Kashgarian mountains.——The Proceedings of the Royal Geographical Society admit the error in the identification of Port Hamilton with Quelpart. Port Hamilton is thirty-eight miles N. N. E. of Quelpart, and is sheltered by three islands, the largest of which, Sodo, is three and a half miles long and 650 feet high at its highest spot. Sanhodo is about half as large and 783 feet high.——Peng Yang, the second most important city in Corea, is more a commercial than a manufacturing center, and is the capital of the province of Puing-an-do. It is more than 200 miles from Söul. Song-to, three days march from Söul, has walls as large as those of the capital, but the town has so dwindled that there is much cultivated land inside.——The Kara-kum, according to M. Lessar, is the region bounded by the Ust Urt, Khiva, Bokhara, Afghan

Turkistan, Attok and Akhal. Though the name signifies a sand desert it is not sandy throughout. The sands are of three kinds. The first is clayey, mixed with sand and covered with small hillocks and brushwood; the second kind consists of real sands which do not drift to any great extent, the drifting portion forming ridges or hillocks; but the third kind, the true *barkhans* or shifting-sand deserts, are without so much as a visible grass blade. Beside these different kinds of sands there are, in the Kara-kum, *kyrs* or tracts of firm clayey surfaces (mixed with sand) consisting of valleys alternating with eminences 140 to 210 feet high; *takirs*, or flat clayey areas surrounded by sands; and *shors* or tracts of hard ferruginous sand lying in the lowest parts of the desert.——The *Izvestia* gives an account of M. Potanin's journey from Peking to Lang-tcheou, in 1884. The country between the Yellow river and Boro-balgasun is covered with sand, rarely moving sand, but *barkhans* fortified by a growth of *shiabyk*, a species of Artemisia, with bushes of Cavagana in the cavities between. Water is plentiful. The dry grounds between the sands are covered with steppe vegetation, and sarrazin, millet and hemp are grown there. The Ordos inhabit this region. Boro-balgasun was once a town but now contains but a few huts within its ruined walls. At Edjin-khoro, on the Tchambkhak river, are two tents in which the bones of Zenghis Khan are said to be preserved. After leaving Boro-balgasun, the expedition visited the salt lake Baga-shikyr, and passed over an almost uninhabited region with ruins of Mussulman villages destroyed when the last insurrection was put down. Lin-tcheou, on the Hoang-ho, is surrounded by fruit gardens, and for fifty miles south of it numerous villages extend along a canal which runs parallel to the Hoang-ho. This richness is of recent origin, for the whole region bears traces of the desolation wrought by the Chinese after the suppression of the insurrection, of which the town of Tsin-tsi-pou was the center. South of this town M. Potanin left the Hoang-ho and crossed the series of flat ridges which rise from 6000 to 7000 feet above the sea, and are covered with loess to a thickness of 200 to 300 feet. The sandstone of these hills contains some beds of salt. The loess covers the whole country from Ping-yang-sia to Lang-tcheou, which is a great city, picturesquely built on the right bank of the Hoang-ho at the foot of a mountain. The population is of Turk origin, and though it has assumed Chinese customs, it keeps its Mussulman religion.

AFRICA.—The route from Benguela to the mission village of Bihé has been approximately surveyed by the Rev. William E. Fay. The sketch maps, contributed to the *Missionary Herald*, cover an area sixty miles wide, extending over four degrees of longitude. The first human habitations met with are at the eastern foot of the coast range. About 100 miles from the coast the Ballombo river is spanned in wet seasons by a native

bridge, whose builders take toll. The mission village lies in about 16° E. long., and 12° 15′ S. lat., in a broad and beautiful valley, densely populated, and lying east of a region of mountains estimated to have peaks from five to eight thousand feet high. ——The death of King Mtesa is confirmed, but it is believed that his son will prove more friendly to civilization than the father. Mirambo is also dead.——The Royal Geographical Society has decided to send out another expedition under Mr. J. T. Last, who will proceed to the confluence of the Rovuma and Lujendi rivers, fix the longitude of the junction, and will then establish himself awhile at the Namuli hills. After a study of this region, Mr. Last will enter the valley of the Likugu, follow it to the coast, and then follow the coast to Quillimane or Angoche.——The Portuguese possess a tract of land on the northern bank of the Congo, extending from Cape Lembo, south of Kabinda bay, to Massabé, and extending inland thirty or forty miles so as to contain Kabinda, Molembo, Landana and Massabé. The whole of the valley of the Kwilu, where the International Association had eighteen stations, is ceded to France.——Parts of the countries of Useguha, Nguru, Usagara and Ukami have, by treaty with "ten independent sultans," been brought under the protection of Germany. The commercial importance of this district is great, since the central trade route to Lake Tanganyika passes through it. After fifty to eighty miles of unhealthy coast region is passed, mountains and plains with much fertile country and sufficient water are reached. The Wa-ngaru, Wa-sagara and Wa-seguha speak nearly the same dialect. The King of the Belgians has resolved to abandon Karema and other stations of the association east of Lake Tanganyika.—— The territory now claimed by Germany in East Africa is usually supposed to recognize the authority of the Sultan of Zanzibar. The rule of this potentate is acknowleged along trade routes for at least 700 miles in the interior, and also by many chiefs away from these routes. The sultan owns 1050 miles of coast besides islands.——In spite of the succession of misfortunes which beset M. Giraud, he has added greatly to our knowledge of Lake Bangweolo. The Luapula leaves the southwest corner of the lake, as shown on Mr. Ravenstein's map.—— Capt. G. A. Chaddock has ascended the Limpopo for a considerable distance. The channel at the bar is narrow, with no less than four and a half fathoms of water. A long sandspit, three miles from the coast, forms a natural breakwater, and the water at the opening is fresh. The river channel is narrow and deep, the surrounding country low and level, and thickly populated. The lower course has no trees save some mangoes at the mouth. Captain Chaddock believes that the Limpopo is free from falls or any obstruction as far as the Transvaal.

AMERICA.—M. Chaffanjon, during an investigation of the hy-

drography of the Orinoco, not only obtained materials for a geological map of the region, but in five different places discovered inscriptions and pictures in granite, made by the natives. These he has carefully copied.——A party commanded by Feilberg, and sent out by the Argentine Confederation to explore the Pilcomayo, found that a trade route via that river to Bolivia is not feasible. Below the rapids, sixty leagues above the mouth, the Pilcomayo receives an affluent not marked on any chart, but with as much water as the Pilcomayo or perhaps even more. It was obstructed by sunken trees. The country along these rivers is rich with fine pasturage.——From Dr. Bell's report of the geological work of the Hudson Bay expedition, it appears that the highest land of the Labrador peninsula is everywhere close to the coast, with a gradual slope westward to the basins of the Koksoak and the rivers emptying into Hudson bay. The formation throughout Northern Labrador and the strait is gneiss, mostly Huronian, but some of it Laurentian.——Punta Arenas, the Chilian settlement in Magellan strait, is a town of 4000 inhabitants, surrounded by splendid lands with abundant pastures, forests and waters. A hill protects the town from the cold winds. The climate is said to be excellent.

GEOGRAPHICAL NEWS.—The fifth and sixth issues of Petermann's Mittheilungen for this year contain an account of Caffraria and the eastern districts of Cape Colony, by H. C. Schunke, with a map (in No. 5) upon a scale of 1 : 750,000. No 5 contains also some remarks upon the health-relations of the region of the Upper Amu Darja, by A. Regel ; and an account of the German Geographical Congress held at Hamburg on April 9 to 11, 1885. On this occasion Doctors Steiner and Claus gave an account of their journey down the Xingu, and Dr. Boas a sketch of the Eskimo of Baffin's bay. No. 6 contains a map of the Panama canal on a scale of 1 : 120,000; an account of the German settlements on the Slave coast, by P. Langhans, and a history of ten journeys in Costa Rica, undertaken by the now expelled bishop, Dr. Theil. The coast line of the German possessions on the Slave coast is short, extending only from 1° 15′ W. to 1° 34′ W. Lome, Bugida and Porto Seguro are situated upon the shore, behind which is a lagoon, the Togo sea, at the mouth of the Raho river. The outlet of this lagoon is at Little Popo, to the east of the Togo territory. Popo is not claimed as German upon the map.

GEOLOGY AND PALÆONTOLOGY.

THE RELATIONS OF THE PALÆOZOIC INSECTS.—At the April, 1885, meeting of the National Academy of Sciences, Mr. S. H. Scudder presented some important views as to the position of the insects of the Palæozoic age in the system. We make the following extracts from his paper :

The modification I would introduce is to this effect: That

while we may recognize in the Palæozoic rocks insects which were plainly precursors of existing Hetercmetabola, viz., Orthoptera, Neuroptera (both Neuroptera proper and Pseudoneuroptera). Hemiptera (both Homoptera and Heteroptera) and perhaps Coleoptera—and no Metabola whatever—a statement almost identical with that previously made, we may yet not call these Orthoptera, Neuroptera, etc., since *ordinal features were not differentiated;* but all Palæozoic insects belonged to a single order which, enlarging its scope as outlined by Goldenberg, we may call Palæodictyoptera; in other words, the Palæozoic insect was a generalized Hexapod, or more particularly a generalized Heterometabolon. Ordinal differentiation had not begun in Palæozoic times.

The grounds for this view are as follows:

1. No group of Palæozoic insects has yet been studied carefully; and it is important to observe that, though our knowledge of them is of necessity fragmentary, yet the more perfectly they are known the clearer is this true; no group, I say, has been carefully studied which does not show, between it and the modern group which it most resembles, differences so great that it must be separated from that group as a whole, as one of equal taxonomic rank, as in the case of three relative groups last mentioned.

2. That the different larger groups of Palæozoic times, of which we now know nine or ten, were more closely related to one another, at least in the structure of their wings (which is the only point of general structure yet open for comparison) than any one of them is to that modern group to which it is most allied, and of which it was, with little doubt, the precursor or ancestral type. Thus the Palæoblattariæ are more nearly allied in the ground structure of their wings to certain neuropteroid Palæodictyoptera of Palæozoic times than to the modern Blattariæ; and yet we can so completely trace in Mesozoic times the transition from the Palæoblattariæ to the Blattariæ that no reasonable doubt can exist as to their descent, the one from the other.

3. The ordinal distinction which is now found in the wing structure of modern insects did not exist in Palæozoic insects, but a common simple type of neuration which barely admitted of family division.

It will appear from this that, by a sort of principle of family continuity, we may recognize in the Palæozoic insects a tendency toward a differentiation in ordinal characters sufficient to enable us in an *ex post facto* fashion to distinguish between orthopteroid, neuropteroid, etc., Palæodictyoptera.

Now when we look at the insects of later formations, we find types of every one of the existing orders of insects—speaking of these orders in their broadest sense, as we have everywhere done in this essay—we find every one fully developed in the Jurassic period.

We find then that the entire change from the generalized hexapod to the ordinally specialized hexapod was made in the interval between the close of the Palæozoic period and the middle, we may say, of the Mesozoic. These significant changes were ushered in with the dawn of the Mesozoic period, and the Triassic rocks become naturally (together with the Silurian) the most important, the expectant ground of the student of palæontology.

Hitherto for fifty years the Carboniferous period has claimed this interest as its birthright.

It would then appear that the geological history of winged insects, so far as we know from present indications, may be summed up in a very few words. Appearing in the Silurian period, insects continued throughout Palæozoic times as a generalized form of Heterometabola which, for convenience, we have called Palæodictyoptera, and which had the front wings as well as the hind wings membranous.

On the advent of Mesozoic times a great differentiation took place, and before its middle all of the orders, both of Heterometabola and Metabola were fully developed in all their essential features as they exist to-day, the more highly organized Metabola at first in feeble numbers, but to-day, and even in Tertiary times, as the prevailing types. The Metabola have from the first retained the membranous character of the front wings, while in most of the Heterometabola, which were more closely and directly connected with Palæozoic types, the front wings were, even in Mesozoic times, more or less completely differentiated from the hind wings as a sort of protective covering to the latter, and these became the principal organs of flight.

GARMAN ON DIDYMODUS.—Mr. Samuel Garman has published a description[1] of the shark *Chlamydoselachus anguineus* Garm., and introduced into his paper some comments on my paper[2] on the extinct shark Didymodus, which has been found in the beds of Permian age in Texas. Mr. Garman's comments are in the form of a criticism which denies the existence of some of the leading points of structure of the skull which I have pointed out. The surprise which these criticisms occasion increases when it is understood that they are derived "from a study of the illustrations," and not of the specimens themselves. And Mr. Garman appeals to "a comparison with the plate in the Proceedings" (of the American Philosophical Society) to "show whether they can be justified" (p. 29). To utter the sweeping conclusions reached by Mr. Garman on such a basis as this, is, to say the least, hazardous; and it is a comparatively easy task to show that they are wrong, by reference to the specimens themselves. On p. 573 of

[1] Bulletin of Museum Comparative Zoölogy, Cambridge, XII, July, 1885.
Proceedings American Philosophical Society, Philadelphia, 1884, p. 572.

my essay I state that twelve more or less complete crania of Didymodus are in my possession. I now add that most of them were in my possession, and were objects of frequent observation by me, for five or six years before my publication in question.

On p. 29 of his brochure, Mr. Garman says:

"3. The skull is unsegmented; the lines of segmentation, so-called, are partly accidentals which are not alike on the two sides of the skull."

To this it must be replied that the lines of segmentation certainly exist, and that they are alike on the two sides of the skull.

"6. The Fig. 4 of the plate should be reversed in direction, the prolonged anterior portion in the figure should be turned backwards from the interorbital region, thus bringing what in the figure serve as orbits behind the postorbital processes."

As I have several perfect skulls of this species, including the one represented in Fig. 1, where the characters are readily seen, the supposition of Mr. Garman that I have reversed the specimen represented in Fig. 4 is simply curious; and as he derives his information from a plate, one is also surprised at the lack of caution exhibited in making the assertion.

"7. The Ichthyotomi, as based on these skulls, have not been separated from the Selachii."

The suborder Ichthyotomi was thus defined in my paper (p. 581): "A basioccipital bone and condyle. Occipital ? pterotic and frontal bones distinct. Supraorbital (or nasal) bones present." Mr. Garman gets over this definition by denying the existence of the segmentation, which, as we have seen, nevertheless exists; and by ignoring the presence of the basioccipital bone and condyle. This would indeed be the muzzle of the skull, were the direction of Fig. 4 reversed, as proposed by Mr. Garman. As the characters above given are proven to exist, I must still regard the genus Didymodus as presenting a type of skull quite different from the true Selachii.

I now add a few comments on other points in Mr. Garman's paper. On p. 21 of his essay Mr. Garman gives five references to the publications where he claims that I have called the *Chlamydoselachus anguineus*, *Didymodus anguineus*." I have, however, never proposed or used this name at the places cited, or elsewhere. On p. 28 it is stated that I have never published my conclusion that these two genera are distinct. This was done in the AMERICAN NATURALIST, 1885, pp. 236–7. Further, a new name is proposed as a substitute for Didymodus (p. 30), because the latter is supposed to have became a synomyme in another connection. Were this the fact, I should still retain as unused the name Didymodus, by which the form is now known; but as it has not yet been positively shown to be distinct from some of the various genera of this group already proposed, the action of Mr. Garman is at least premature.—*E. D. Cope.*

ON THE ANTHRACARIDÆ, A FAMILY OF CARBONIFEROUS MACRUROUS DECAPOD CRUSTACEA, ALLIED TO THE ERYONIDÆ.[1]—Having been kindly favored by Messrs. R. D. Lacoe and J. C. Carr with the opportunity of examining their collections of nodules from Mazon creek, containing *Anthrapalæmon gracilis* Meek and Worthen, I have been able to discover some features probably not shown in the specimens examined by those palæontologists. The newly observed characters are the carapace with its rostrum, showing that the American species in these respects closely resembles the European ones figured by Salter, the founder of the genus. Moreover, specimens show the entire thoracic legs, while the antennæ of both pairs were almost entirely shown. The fact that the first pair of thoracic feet were scarcely larger than the succeeding pairs shows that Anthrapalæmon cannot be placed in the Eryonidæ, but should form the type of a distinct group of family rank, none of the existing Macrura having such small anterior legs. At the same time the Carboniferous Anthracaridæ were probably the forerunners or ancestors of the Mesozoic and later Eryonidæ.

The genus Anthrapalemon, a Carboniferous fossil, was first described by J. W. Salter in the Quarterly Journal of the Geological Society of London, (XVII, 529, 1861). The name given to the fossils has, the author remarks, "only a general signification, and is not intended to indicate a real relation to Palæmon." He also remarks that "the genus is not to be confounded with any of the Liassic or Oölitic ones published by von Meyer, Münster, &c. * * * It is broader than the general form of the Astacidæ, or than Glyphæ and its Liassic allies, but much narrower than Eryon." Salter's type species is *Anthrapalæmon grossarti* Salter. With this species the American *A. gracilis* is congeneric. A closely allied English form of *A. dubius* Prestwich, is referred by Mr. Salter to the subgenus Palæocarabus, a name less fitting than Anthrapalæmon. The telson, unlike that of any other macruran, fossil or recent, so far as I am aware, is differentiated into three portions: the basal, central piece is somewhat polygonal, a little longer than broad; it is separated by a distinct suture from a small triangular terminal piece which forms the apex of the telson. Between the outer half of the entire telson is a large broad lobe which is fringed with setæ. At first I regarded it as a subdivision of the inner lobe of the last uropoda or abdominal feet, but no instance among the Decapoda is known to us in which the last pair of uropoda have more than two lobes or divisions, and I have therefore been inclined to associate the innermost of the three setiferous lobes with the telson, and to regard the telson as divided into two median and two lateral lobular setiferous portions. Whether the two lobes belong with the telson or uropoda I will leave for the present an open question.

[1] Read before the National Academy of Sciences, April, 1885.

The only group in existence in which the telson is so remarkably differentiated is the Galatheidæ. In Munida the telson is divided by sutures into four pieces, the two terminal ones lobed and edged with setæ of the same size as those of the uropoda. In Eumunida of Smith the telson is " short and broad, more or less membranaceous, and divided by a transverse articulation, so that the distal part may be folded beneath the basal part." In *Anoplotus politus*, like the foregoing a deep-sea galatheid, the telson is stiffened by eight distinct calcified plates, a broad median basal plate, with a small one on either side at the base of the uropod and a small median one behind it and between a pair of broad lateral plates, still behind which there is a second pair which meet in the middle line and forms the tips and lateral angles.

From the nature of the differentiation of the telson in the Galatheidæ I am inclined to believe, from what I have observed in the specimens before me, that the telson of Anthrapalæmon is sub divided in nearly the same manner. If so we cannot refer the genus to the Eryonidæ, and we would therefore regard it as the type of a distinct family which may thus be briefly characterized:

Family Anthracaridæ: Body broad and somewhat flattened, in general appearance like the Eryonidæ, but with the first pair of thoracic legs no larger than the four succeeding pairs; carapace with a long acute rostrum, with lateral spines on the anterior half, the telson differentiated into two median pieces, with two lateral broad rounded membranaceous lobes, fringed like the uropoda with large setæ.

In anticipating the differentiated telson of the anomurous Galatheidæ, this eryon-like shrimp is not an exception to the rule prevailing in the old-fashioned Carboniferous forms, which seem, in most cases, to be synthetic or ancestral types. The Eryonidæ, which began to exist in the Mesozoic age, have persisted to the present time, being represented by certain deep-sea forms, *i. e.*, Willemœsia and Pentacheles; on the other hand the Anthracaridæ appear to have become extinct at the end of the Palæozoic age, and the question naturally arises: Did they stand in an ancestral relation to the Mesozoic and modern Eryonidæ? Appearances certainly indicate that the Eryonidæ, and perhaps the Astacidæ, may have descended from a group at least closely allied to the Anthracaridæ.—*A. S. Packard.*

The Geological History of New Zealand.—Capt. F. W. Hutton, in an article upon the origin of the fauna and flora of New Zealand (*Ann. and Mag. Natural History*, February, 1885) arrives at the following conclusions: New Zealand, which formerly existed as the southern part of a continent extending through Australia to India, was isolated from Australia toward the close of the Jurassic period, but was attached to a South Pacific continent and received a stream of immigrants

from the north. None arrived from the south because Fuegia was not then in existence. In the Upper Cretaceous the land shrank to a size considerably smaller than at present. In the Eocene, elevation took place, and New Zealand extended outwards in all directions, but remained isolated. Plants and animals came in both from the north and from the south. In the Oligocene and Miocene periods New Zealand was, except for a short interval, a cluster of islands, but was upraised once more, and obtained more immigrants from north and south during the Pliocene, after which subsidence occurred, and the land throughout the South island and southern half of the North island sank considerably below its present level, to be again elevated during the Pleistocene.

GEOLOGICAL NEWS.—*Jurassic.*—M. Cotteau has studied more than 500 Echini from the Jurassic of France. The Jurassic seas, not very deep, with broken shores, numerous isles and many extensive coral reefs, presented conditions eminently favorable for the existence of Echini. The evolution of the fifty genera described by M. Cotteau is of great interest. Some are special to the beds they occur in, and nothing in the beds above recalls their existence, while others have a curious persistence. Cidaris has subsisted from the Trias to the present day.

Cretaceous.—Herr A. Schenk has described the fossil woods of the Libyan desert belonging to the Upper Cretaceous. Many are petrified. —— At the Academy of Sciences of Paris (May 25), M. Hebert presented a note by M. Ch. Velain upon the Penean formation, which in the Vosges takes a large share in the constitution of the secondary chains, filling some very large depressions. Except at some points where it is raised to the summit of mountains 600 to 800 meters high, it is covered by the Vosgian sandstone, and it lies upon the Carboniferous or gneiss. It is usually a red clayey sandstone, passing into a fragmentary conglomerate which unites it to the Vosgian below.

Tertiary and Quaternary.—The British Eocene land Mollusca are treated of by J. S. Gardner, in the *Geological Magazine* for June, 1885.——C. Schwager enumerates the foraminifera of the Eocene of Egypt and the Libyan desert. About sixty new species are described, excluding the nummulites which have been monographed by P. de la Harpe, and of which twenty-five species occur. The Eocene corals of the same region have been described by E. Pratz.——Messrs. P. M. Duncan and W. P. Sladen have monographed the Tertiary Echinoidea of Kachh and Kattywar (Palæontologia Indica, Ser. XIV). The Eocene of this region is classified in four groups, the two uppermost of which contain Echini. In the nummulitic group of Kachh twenty-two species were found, in the Oligocene above it five species, and in the Miocene sixteen species. All the Echini of Kattywar were Miocene, and

of the thirteen species six occurred in the Miocene of Kachh. Thirty-one of the foregoing are new. The same authors have monographed the Echini of Scinde, in all twenty-six genera and forty-two species, about twenty-six of which are new.——Th. Fuchs has described the Miocene fauna of Egypt and the Libyan desert. His work brings the neogene species of Lower Egypt up to 129. The new species are *Turritella distincta*, *Pholas ammonis*, *Pecten zitteli*, *fraasi* and *geneffensis*, *Ostræa vestita* and *pseudo-cucullata*, *Placuna miocenica*, *Brissopsis fraasi*, *Agassizia zitteli*, *Echinolampas amplus*, *Clypeaster rohlfsi*, *sub-placunarius* and *isthmicus*, *Scutella ammonis* and *rostrata*, and *Amphiope truncata* and *arcuata*. ——*Cervalces americanus* Scott = *Cervus americanus* Harlan, is described by Professor W. B. Scott (*Science*, 1885, 420) from an almost perfect skeleton found in Warren county, N. J. It was a very large animal, with large head, short neck and trunk, legs much longer than those of the great Irish deer, and antlers which were palmated, though less so than in the moose. There is a bezant antler and a posterior tine given off from the beam opposite to it. The two tines are connected by a flaring process of bone which descends below the level of the eye. The premaxillæ are stag-like, and join the nasals, which are much longer than in the moose. The nostrils were smaller, and there was evidently no such a proboscis-like snout as in the moose. Cervalces agrees with the moose in having the lower ends of the lateral metacarpáls present, and on the whole is more like Alces than it is like Cervus.——Professor Owen (Trans. Zoöl. Soc. London, 1883) describes the skeleton of *Dinornis parvus*. This smallest of the genus has proportionally the largest skull.——The *Geological Magazine* for April contains an interesting article upon the oscillations of level on the south coast of England. The May issue of the same magazine has an account of the inland seas and salt lakes of the glacial period, by T. F. Jamieson.——A new locality for diamonds is Salobro (brackish) behind the flat coast of the southern part of the province of Bahia, near the junction of the Rio Purdo with the Jequitinhonha, at the foot of the Serra do Mar. The diamonds occur in a disintegrating clay, apparently of quite recent origin, resembling the alluvium of existing rivers, and not exhibiting that rounding of the materials usually so characteristic of Brazilian diamond sands. It encloses few minerals compared with other sands; quartz is most common, next monazite in yellow and red crystals and zircon in brown to white, but seldom violet crystals; while staurolite, almandine, corundum and various iron ores are rarer. This is the first occasion in which corundum has been found in diamond beds, while tourmaline and other characteristic minerals are wanting.——Mr. D. Pidgeon (Quart. Jour. Geol. Soc.) gives an account of some recent discoveries in the submerged forest of Torbay, Eng., and maintains, contrary to received opinion, that "while some of the so-called peat-beds

of the forest are not older than Roman times, the clays in which the forest is rooted are either coëval with or younger than the bronze age in Britain." In December, 1883, the sea tore away the beach so as to expose this clay, at the junction of which with the Trias were found hearths of trap rock with bits of pottery, grindstones, glass, tin, slag and ingots of copper, leading to the conclusion that tin was smelted and bronze made prior to the deposition of the forest clay upon the surface of the Trias rock. Submergence need not be predicated, the damming back of the sea and the growth of trees below high-water mark behind the dam furnish a probable explanation of the phenomena.

MINERALOGY AND PETROGRAPHY.[1]

AMPHIBOLE-ANTHOPHYLLITE FROM MT. WASHINGTON, BALTIMORE COUNTY.—A light-gray or brownish colored mineral, with a bronzy luster, occurs in considerable quantity as a gangue of the chalcopyrite ore which is mined a short distance north-west of the village of Mt. Washington, Baltimore county, Md. It is most frequently found in thin blade-like individuals varying much in size and with only faint indications of crystal planes. Such masses contain, beside the chalcopyrite, abundant, sharply defined octahedral crystals of magnetite. The bronzy mineral has a fibrous structure and in all respects resembles anthophyllite. During the past fall blades of unusual size ($10^{cm} \times 2^{cm}$) were found, which had the planes $_{\infty}P\overline{_{\infty}}$ and $_{\infty}P$ of the prismatic zone well developed. The angle between the planes of the prism (124° 30′) placed the hornblendic nature of the mineral beyond a doubt. The great purity and transparency of some of the material seemed to invite a chemical and optical examination which was accordingly undertaken by Mr. C. S. Palmer, of the chemical laboratory of the Johns Hopkins University. Some specimens of a reddish-brown color were translucent—almost transparent—though 2^{mm} in thickness. In these the usual fibrous structure parallel to the vertical axis was hardly noticeable, but a parting parallel to a very flat clinodome was quite pronounced.

A chemical analysis of this freshest and most homogeneous material gave the following results:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	total
57.26	0.75	1.73	15.64	tr.	21.70	2.80	tr.	99.88

This will be at once recognized as the composition of a typical anthophyllite. The specific gravity is 3.068. No pleochroism is visible in thin sections, but in transparent crystals of considerable thickness a decided difference both in the color and intensity of the rays is observable. The one vibrating parallel to $\dot{c}$ is a light copper-red, while that parallel to $\bar{b}$ is yellow. Absorp-

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore.

tion $\dot{c} > \bar{b}$. No satisfactory sections parallel to the clinopinacoid for the determination of the $\breve{a}$ ray were obtained. In converged polarized light sections parallel to $_{\infty}P\overline{\infty}$ showed one optical axis somewhat out of the field, so that only a dark brush was seen to pass as the stage was revolved. The exact measurement of the extinction in sections parallel to the clinopinacoid was not easy on account of the fibrous character of the mineral. Different values were obtained on different fibers, the largest and most frequent being from 22°–25°.

There can therefore be no doubt that this mineral is really monoclinic in spite of its chemical composition and general resemblance to the orthorhombic anthophyllite. This fact is of interest in connection with the observations of Des Cloizeaux on an exactly similar mineral from Königsberg and Greenland, for which he first proposed the name amphibole-anthophyllite.[1] Groth has remarked that a considerable proportion of the minerals commonly called anthophyllite are probably monoclinic in their crystallization.[2] Zeparovich has recently noted the occurrence of amphibole-anthophyllite at Schneeberg in Passeyr.[3]—*G. H. Williams.*

New Planes on Hornblende Crystals.—In Vol. viii of his Materialien zur Mineralogie Russlands, 1881, N. von Kokscharow enumerates eighteen forms as heretofore observed on the mineral hornblende. Of these five only b ($_{\infty}P\breve{\infty}$), e ($_{\infty}P\breve{3}$), M ($_{\infty}P$), u ($_{\infty}P\bar{3}$) and a ($_{\infty}P\overline{\infty}$) belong to the prismatic zone. One other, g ($_{\infty}P\bar{2}$) was added by Franzenau from his studies of the hornblende from Aranyerberg, in Hungary.[4]

Certain dark-green crystals of hornblende (pargasite) occurring at East Russell, St. Lawrence county, N. Y., although having but few lusterless terminal planes, possess in the prismatic zone a wealth of forms which has never before been observed on this mineral. All the above-mentioned planes, a, n, g, M, e and b, were determined by measurement, and also two others, x ($_{\infty}P\breve{5}$) and y ($_{\infty}P\breve{7}$). Accepting the axial ratio of von Kokscharow a : b : c = .548258 : 1 : .293765 — $\beta = 75°\ 2'$, the angle between these planes and the clinopinacoid b are

	measured	calculated
For x	159° 23′	159° 18′ 48″
For y	165° 8′	164° 54′ 20″

On these crystals, as usual, the planes a, n, M, e and b are the commonest, g and x are, however, not uncommon; y was observed on only one crystal, where it was bright and well developed.—*G. H. Williams.*

[1] Nouvelles Recherches sur les propriétés optiques des cristaux, 1867, p. 114.
[2] Mineraliensammlung der Universität Strassburg, 1878, p. 228. Tabellârische Uebersicht der Mineralien, 1882, p. 105.
[3] "Lotos," 1883.
[4] Zeitschrift für Krystallographie, viii, 1883, p. 568.

LEUCITE.— Professor H. Rosenbusch[1] of Heidelberg, has recently made the most interesting observation that the morphological no less than the optical characters of the mineral leucite can be brought into full accord with the regular system by a sufficient increase of temperature. It is well known that this mineral was regarded as the very type of an isometric icosatetrahedron until vom Rath showed that considerable variation from the calculated angles as well as frequent twinning lamellæ parallel the face $_{\infty}O$ necessitated the assumption of a tetragonal symmetry. The double refraction of this substance was also a point in favor of this view. The recent studies of Klein, Merian and Penfield have, however, shown that above a certain temperature leucite, like boracite, becomes altogether isotropic and now Rosenbusch finds that by the same means the twinning lamellæ, ordinarily visible as a system of fine striations, may likewise be made to disappear. A crystal upon which these were unusually distinct was brought in focus under the microscope by reflected light in such a manner that the main face appeared bright while the lamellæ were in the shadow. Heat was now gradually applied and the most remarkable effect observed. A kind of undulatory motion was noticed and whole groups of lamellæ would disappear at one point and reappear at another, until finally, at the requisite temperature, all were gone and the face was seen to be quite uniform and even. Upon cooling the lamellæ returned but in a different position from that which the original ones occupied. So great was the molecular disturbance here produced, that after some repetitions of the experiment on the same crystal it fell to pieces. The supposition is made that leucite crystallizes in the regular system at high temperatures, and in some other unknown system at ordinary temperatures. The effort of the molecules to suit their arrangement to the altered conditions produces a tension which finds relief in the formation of secondary twinning lamellæ parallel to the slipping plane ("gleitfläche"), which in this case is $_{\infty}O$. When the temperature is raised this tension is of course removed. The attempt will be made by the same investigator to measure a crystal of leucite on a reflection goniometer at the temperature necessary for the obliteration of the twinning lamellæ, when it is expected that the interfacial angles will agree perfectly with the regular symmetry.

BOTANY.[2]

THE ABUNDANCE OF ASH RUST.—In Eastern Nebraska, this year has been remarkable for the great abundance of the ash rust (*Æcidium fraxini*) upon the leaves, petioles and twigs of the green ash. In many instances each leaflet contained from ten to

[1] Neues Jahrbuch für Min., etc., 1885. II, p. 1.

[2] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

twenty of the characteristic spots, varying from a tenth to a quarter of an inch in diameter. The petioles and partial petioles were frequently greatly distorted and enlarged, and in many cases the young twigs were swollen out into rounded nut-like growths which were covered with the tubular Æcidia.

The injury produced by this rust in Lincoln was quite considerable, as green ash trees have been very largely planted along the streets for shade and ornament. These planted trees appear to have suffered more than the native ones along the streams, although the latter were by no means free from the parasite.

I have as yet been unable to obtain any clue to the further development of the ash rust. One would look for a correspondingly great growth of red and black rust upon some of the plants of this region, but so far I have not observed any indication that such is the case.—*Charles E. Bessey.*

THE FERTILIZATION OF THE WILD BEAN (*Phaseolus diversifolius*).—The flowers (Fig. 1) of the wild bean when fresh are of a pretty rose-purple color, turning to a sort of dirty flesh color in fading. This change of color occurs at a time when insect visits are no longer necessary to the flower and no doubt serves to inform the insect that it has no food to offer. The two wings are free from the keel but lie close to it; they furnish an *alighting* place

Fig. 1.

Fig. 3.

Fig. 5.

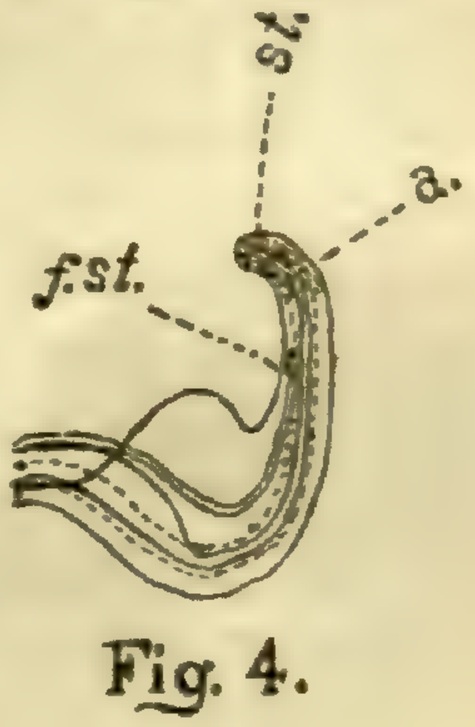

Fig. 4.

Fig. 2.

FIG.—Flower of wild bean, seen somewhat from below. FIG. 2.—Keel and wings. FIG. 3.—Keel alone, showing lens-shaped base. FIG. 4.—Enlarged section of keel with style enclosed. FIG. 5.—The same with style projecting; *st*, stigma; *f. st*, free stamen; *a*, anthers of connected stamens. The dotted lines indicate the course of the united filaments.

for the middle-sized bees which visit it (Fig. 2). The keel itself has the form of a vertically placed lens at its base, narrowing above into a narrow tube, which encloses both stamens and styles (Fig. 3). The anthers lie about the hairy end of the style and shed their pollen upon it. After this has escaped the free ends of the filaments shrivel up and allow the somewhat freer movement of the style. The anthers never leave the keel. Nine of the stamens are united by their filaments, but the tenth is free. In

their natural state both stamens and style are included by the keel and lie along the lower portion of the dilated part of the keel (Fig. 4).

When a bee visits the flower it alights upon the wings on the left side of the keel. In its struggles to get at the honey, it pushes down the wings, these carry with them the keel, and their combined motion forces out the hairy end of the style, while the peculiar curvature of the keel directs its stigma to the side and back of the bee (Figs. 5 and 1). In this act the stamens and style are in reality passive. They lie at first along the bottom of the keel, the depression of the keel pulls it away from the stamens and draws its tube down from the style, the small opening at its end forbidding the extrusion of the stamens. The pollen collected on the hairs of the style is left on the back of the bee and the stigma receives fresh pollen from some other flower which had been left on the back of the insect during some previous visit. As soon as the bee leaves the flower the parts again resume their normal position. The mechanism of the flower is similar to that of *Ph. vulgaris*, but lacks the double spiral of the keel.—*Aug. F. Foerste, Granville, Ohio.*

The Movement of Protoplasm in the Styles of Indian Corn.—It will not be too late when this appears in print for students in botanical laboratories to study the movement of the protoplasm in the long styles ("silks") of the Indian corn. By taking a young style from an ear which has been kept in a warm place for an hour or so, clipping off a piece a couple of inches in length and carefully mounting it in water under a large cover-glass, there will be no difficulty in seeing a great deal of activity in the protoplasm. Care must of course be taken to have the style lie flat, remembering that it is not cylindrical in shape, but somewhat ribbon-shaped. The cells are much elongated and the walls are so transparent that with careful focusing their contents may be seen, even in the interior parts of the style.

The protoplasm is sufficiently granular to be easily seen. It moves along the side of the cell in a strong steady stream, occasionally heaping up a great mass, which is eventually pushed onward by the current. As an easily obtained and instructive example of protoplasmic activity I know of nothing which is superior to such a specimen.—*Charles E. Bessey.*

Bacteria as Vegetable Parasites.—The only genuine instance of parasitic bacteria in plants yet mentioned in the books (De Bary, Zopf, etc.) is that of the yellow sickness of hyacinths, first described by Dr. Wakker, of Amsterdam, in 1882. This bacterium winters in the bulb scales, and increases in the spring to slimy yellow masses which destroy the tissues and eventually kill the plant. The priority of demonstrating parasitic bacteria in plants belongs, however, to an American. In 1880, two years

before Dr. Wakker's announcement of bacteria in hyacinths, Professor T. J. Burrill, of Illinois, presented a paper before the American Association for the Advancement of Science demonstrating the invariable presence of characteristic bacteria in the disease known as "pear blight," which attacks pomaceous trees, and that the disease may be transmitted from tree to tree by inoculation. Since then the bacteria have been isolated and cultivated in artificial media, and the statements of the original paper fully confirmed. Americans should have credit for what little original work they do accomplish in bacteriology.—*J. C. Arthur, in Botanical Gazette.*

WORK FOR THE BOTANICAL CLUB OF THE A. A. A. S.—This organization, with its large yearly attendance, may well undertake some work which has been long neglected in this country. We do not forget that the principal object of its founders was to bring the botanists together for social purposes, and are rejoiced to know that in this respect it has accomplished much. Many of the lonely botanists living in remote parts of the country have been gladdened and encouraged by meeting their fellows and consulting upon means and methods. This result is in itself a justification of the existence of the club.

But this should not be all. At every annual meeting some progress should be made in the effort to bring about concerted action among the botanists of the country with regard to many matters. We will venture to suggest here some things which might well occupy a part of the time of the club.

1. In view of the rapid increase in what may be termed popular cryptogamic botany, it is desirable that there should be uniformity in the use of English names of the species and groups. For example, to what group shall we apply the name of the mildews? or the blights?

2. Cannot the botanists do somewhat to bring about greater uniformity in the pronunciation of botanical names and terms? That this is needed requires no further demonstration than that afforded by a single session of the club. We believe that the time is not far distant when botanists must listen to our Latin scholars, and take steps which shall lead to a pronunciation in conformity with what is now regarded as the best Latin usage.

3. The question of the publication of botanical papers (aside from those of systematic interest) may well demand attention. We have several journals devoted to botany alone, and several others maintaining botanical departments. Now, might it not be well to provide for a "division of labor" here, so that each journal might develop its particular branch or department? Moreover, might not the club arrange for a more general distribution of botanical papers (articles) by a general system of exchange?

4. The relations of the botanists of the country to the National Herbarium might be made the subject of discussion and action,

with profit, we apprehend, to the botanists and also to the National Herbarium.—*Charles E. Bessey.*

Botanical News.—The subject of bacteriology received especial attention in the July number of the *Botanical Gazette*, there being no less than a dozen notes and notelets devoted to it, besides four reviews of books upon the same subject.——Clara E. Cummings, of Wellesley, Mass., has prepared a neat catalogue of the Musci and Hepaticæ of North America north of Mexico, which will prove useful to botanists who collect specimens in these classes of plants. The arrangement of the mosses is based upon Lesquereux and James' Manual of Mosses, and that of the liverworts upon Underwood's Catalogue of the North American Hepaticæ. There are enumerated 888 species of mosses and 231 of liverworts, besides many varieties. Copies may be procured of the author for thirty-five cents each.——The Bulletin of the Brookville Society of Natural History, recently issued, contains two articles of botanical interest, viz., The Flora of Franklin county (Indiana), by O. M. Meyncke, and Microscopical Notes, by E. G. Grahn. The former is restricted to the "exogens," and is little more than a bare list, containing but few notes. The second paper contains a list of diatoms and desmids.——A late number of the Bulletin of the Chicago Academy of Sciences contains a readable paper by W. K. Higley on the Northern pitcher plant, or the side-saddle flower (*Sarracenia purpurea* L.). To it are appended several tables of chemical analyses of the fluid contained in the pitchers. It appears that its acidity, which may be very slight at the beginning, increases with the age of the leaf. The acids detected were hydrochloric, sulphuric, carbonic, malic and citric, and respecting these our author says: "To just what acid, if any particular one, the reaction was due in the liquid of the earlier pitchers is not certain, but in the two last months both malic and citric acids appeared, the former in great abundance." As to the origin of the fluid Mr. Higley says: "As a result of the examination of over eight hundred leaves, I find that none contained any fluid before they had opened. These were collected from several localities. After opening there is no fluid till after the first rain, except in a few cases when there has been a heavy dew."——The July *Journal of Botany* contains an interesting review (by Häkel) of Nägeli and Peters' Hieracien Mittel-Europas. The number of species is 164, but the subspecies, varieties and sub-varieties bring up the number of "kindreds" to 2000. In discussing their relationships "it is shown that the kindred forms are of unequal systematic value, and that the species consists partly of individual kindred forms and partly of groups of them."

ENTOMOLOGY.

A NEW SPECIES OF CRAMBUS INJURING CORN ROOTS.—On the 7th of June, 1883, my assistant, Mr. Webster, who had been detailed to study the work of the black-headed grass maggot in corn fields, brought to the office some supposed cutworms, bristly reddish larvæ, which he had found gnawing the roots of corn below the surface, in fields in McLean county, on both old and new ground.

They were not seen again during this season, but on the 19th May of the present year I received the same species from Mr. E. Gastman, superintendent of public schools at Decatur, with the information that they had been sent him from Harristown by a farmer who reported that they were doing serious damage to the roots of his young corn.

On the 27th May, I visited Dwight for the purpose of searching the fields of Mr. Mills from which the web worm had been sent me. The corn in this field was injured most in patches. Over one area of about one-fourth of an acre, many hills were missing, and fully one-third of those remaining were damaged, with a plant occasionally killed. Upon digging into the affected hills the caterpillars were found just beneath the surface, sometimes as many as five or six in a hill, each in a retreat formed by loosely webbing together a mass of dirt irregularly cylindrical in shape, one and one-half to two inches long, and about one-half an inch in diameter. The worm was found in a silk-lined tube within this mass (the tube not always perfectly constructed), which in some cases opened at the surface, its presence being indicated by a circular opening about the size of wheat straw, in the earth next a stalk of corn.

The first attack upon the plant was made by gnawing the outer surface beneath the ground and above the roots. Occasionally the stalk was completely severed, as by a cutworm, but usually not, the larvæ showing rather a disposition to work upwards, eating a superficial furrow or burrowing lengthwise along the center of the stem. In other parts of the field, only here and there a stalk was attacked. The foliage was also frequently eaten, the lower leaf first and then the upper ones, the larva evidently leaving its burrow for this purpose. The tips of the leaves were eaten off, or irregular elongate holes were eaten through them—probably at night, as I have never seen the larva abroad by day. Where the corn was largest, webbed masses of dirt were frequently found which contained no larvæ, a fact which I was at first inclined to suppose indicated that the insect inhabiting them had transformed, especially as the larvæ found were of quite uniform size and apparently full grown. I failed to find a single pupa, however; and as our breeding experiments did not yield the insect for more than a month, it seems more likely that these empty webs had

been abandoned by worms which had gone in search of younger stalks.

On the 7th June, after several hours of careful search in cornfields near Lexington, McKean county, where I selected by preference the least thrifty fields, I found no living larvæ, and but a single mass of webbed dirt at the base of a stalk precisely similar to those formed by the web worm, the hill containing it having been evidently damaged some time before.

A number of the larvæ were brought to the office and placed in earth in a breeding cage on the 28th May. On the 14th June those in the breeding cage were transferred to fresh corn. Many of them were dead, but nine active specimens remained. On the 30th the corn was renewed and another search was made. No larvæ were found and but two living pupæ. A single imperfect moth was released from the earth in which it had completed its transformations, but it was not able to expand its wings and could not be determined. One of the other pupæ was unfortunately crushed by accident, and the other was badly infested by mites which clung closely to its crust about the head with inserted beaks. These were carefully picked away, and this sole remaining pupa was returned to thoroughly calcined earth to complete its transformation. On the 22d July it emerged as a small gray moth, evidently belonging to the family Pyralidæ.

From Professor C. H. Fernald, to whom I referred the specimen, I learned that it was a species of Crambus, new to him and probably undescribed. It is described as *Crambus zeëllus* Fernald, and is known to inhabit Maine, Penna., W. Va., Illinois and Missouri. On the 3d July Mr. Mill, of Dwight, wrote me that the larvæ had almost entirely disappeared from the corn fields, and that the season had been so favorable to the crop that no perceptible damage had finally resulted, with the exception of the loss of a few hills here and there.

The small size of the individuals observed earliest in the season perhaps makes it possible that they came from the egg last spring; and the brood represented in our collections must have completed its development by the end of July. Whether a second brood appears is altogether uncertain.

The injuries inflicted occur so early as to permit replanting in most seasons in case they should prove to be of serious import; and this species is consequently to be classed with the cutworms so far as the effect of its injuries to corn are concerned.—*S. A. Forbes, from advanced sheets of Report of State Entomologist of Illinois for 1884.*

Unusual Abundance of Grasshoppers in Colorado—Since the latter part of May Western newspapers have, from time to time, contained alarming reports of swarms of young locusts or grasshoppers in the valley of the Arkansas and in other portions

of the State of Colorado, and the fear was expressed that Kansas, Nebraska and Missouri would be visited by an invasion of the Rocky Mountain locust (*Melanoplus spretus*). Under direction of Professor Riley, Mr. Lawrence Bruner has visited the portions of Colorado from which rumors came. His report has just been received, and is of such a nature as to allay all fears.

The principal reports were from Salida, Rico, Cañon City and Pueblo. During his sojourn in the State he visited all points along the line of the Denver and South Pass R. R., between Denver and Leadville, and from Leadville followed down the Arkansas river, stopping at Buenavista, Salida and Cañon City, and then going to Granite, Pine creek, Garros and Como. In every locality visited, from which grasshoppers were reported, it was found that the numbers had been greatly exaggerated, and in no case was the migratory species found. All reports arose from a rather undue abundance of native species, which are present every year, and most of which have their preferred food plants in the shape of wild growth and noxious weeds.

Mimicry of a Dragon-fly by a Sumatran Butterfly.—By the margin of a small stream I caught *Leptocircus virescens*, which derives protection from mimicing the habits and appearance of a dragon-fly, in a crowd of which it is often to be found. In form it reminded me of the European genus Nemoptera. It flits over the top of the water fluttering its tails, jerking up and down just as dragon-flies do when flicking the water with the tip of their abdomens. When it settles on the ground it is difficult to see, as it vibrates, in constant motion, its tail and wings, so that a mere haze, as it were, exists where it rests.—*Forbes' A Naturalist's Wanderings in Sumatra.*

Edible Mexican Insects.—According to Mr. J. M. Carter, superintendent of the telegraph lines of the Mexican National R. R., to whom I was indebted for much kindness while in Mexico, the larva of an ant is eaten as food by the Otomite Indians; the ants living in oven-like hills.

Mr. Carter also told me that a caterpillar about two inches long, which lives within the thick leaves of the maguey or century plant, is eaten either raw or cooked by the Mexican Indians. It was not to be found in March at the time we were in Mexico, but in July, when it is often abundant. It is apparently a species of Noctuidæ.—*A. S. Packard.*

Entomological News.—Among the more remarkable insects of Turkestan, reports H. Lansdell in *Nature* for May 21, is a wingless saw-fly, related to the Selandriæ. Affected by this absence of wings, the thorax undergoes important changes, and appears greatly swollen, and all the females generally have the appearance of little bags.———Among the Orthoptera of Turkestan are two species of locusts whose ravages have been com-

plained of in the neighborhood of Perovsk, while a third kind called "pruss" have been destructive in the Zarafshan valley.——In the *Annales des Sciences Naturelles* for Dec., 1884 (received in July, 1885). M. Viallanes publishes an important paper on the optic ganglion of *Æschna maculatissima*, illustrated by three phototypic plates. He also is working at the nervous centers of the Orthoptera.——A Naturalist's Wanderings in the Eastern Archipelago, by Henry O. Forbes, contains many interesting notes regarding the insect life of Java, Sumatra and the Moluccas, as well as Timor.——It appears from the report of Professor Snow, entomologist of the State Board of Agriculture of Kansas, that the Hessian fly has greatly increased in that State, having appeared in fifty-seven of the eighty-one organized counties. This increase in area of distribution is to be accounted for from the fact that the species is two-brooded, and that the second or spring brood made its presence felt in many counties in which the first brood was not sufficiently numerous to attract attention. A new destructive insect is the web-worm, a pyralid caterpillar whose ravages have been thus far confined to Kansas, and has been injurious to corn and potatoes. It is said to occur in Texas, where it is known as the cotton-worm.

ZOÖLOGY.

THE SKELETON OF THE MARSIPOBRANCHI.—Mr. W. Parker contributes to the Transactions of the Royal Society, 1883, a study of the skeleton of the marsipobranchs. At the outset he states that the hag and Bdellostoma are a greatly modified and arrested sand lance or Ammocete, and that a larval frog is also a marsipobranch. He remarks: I feel satisfied that the Anura have only gradually become metamorphosed, and I doubt whether *all the larvæ of Pseudis* undergo that change, even now." The adult lamprey, like the tadpole, is truly suctorial, but the mouths of the Ammocete or larval lamprey, and of the Myxinoids, are not modified into a circular sucking ring, but remain as a small hooded opening fringed with short barbels.

All the cartilage of the hag fish is *cephalic*, for even the farthest rudiment of the dorsal part of the branchial basket is supplied by the vagus nerve, and the spinal region is only supported by membrane or fibrous tissue. No cartilaginous rudiments of vertebral arches can be found. Notwithstanding the ammocetine type of the Myxinoids, they come near to the lamprey in some particulars, and in the perfection of the cranial basket-work, the specialization of the respiratory pouches, the presence of a prenasal median cartilage, and the cartilaginous rings which encase the long tube opening to the olfactory sac, they go beyond it, as also in the development of the *lingual* suctorial apparatus. Professor Huxley and Mr. Parker agree

in thinking that in the transformed lamprey there is a true mandibular rudiment.

THE STAR-NOSED MOLE AMPHIBIOUS.—On June 7th, 1885, we were favored with the opportunity to witness the skill and ease with which a star-nosed mole *(Condylura cristata)* propelled itself through the water. Standing near an expanded portion of a clear meadow brook, we noticed an object moving rapidly near the bottom. So swift were its movements that the eye was troubled to follow them. The zigzag course which the animal followed as it passed between the stones was suggestive of the movements of a frog, seeking refuge when frightened. After leaving the center of the pool it swam directly and rapidly to the opposite bank, keeping under the water all the time, and entered one of its galleries, which we afterwards found in trying to capture the specimen. A very interesting note on the amphibious habits of this mole was given by Dr. C. Hart Merriam in *Science*, Vol. IV, No. 92, Nov. 7, 1884, p. 429.—*A. K. Fisher, M.D., Sing Sing, New York, June, 1885.*

IRIDESCENCE IN THE OREGON MOLE.—In examining alcoholic specimens of *Scapanus townsendi* Bachman, from Klamath basin, Oregon, kindly presented to me by Captain Chas. E. Bendire, U. S. A., I have been surprised to observe a play of iridescent metallic colors, particularly when the animals were viewed by reflected light. The prevailing tints are purple, lilac, and bronze, often showing a rich coppery or brassy luster.

It was doubtless a similar condition which led Cassin to apply the names *S. æneus* and *S. metallescens* to an alcoholic specimen in the museum of the Philadelphia Academy.[1]

I am informed by Dr. Geo. E. Dobson, F. R. S., that the brilliant hues of the African genus Chrysochloris are much intensified by immersion in spirits.—*C. Hart Merriam.*

THE PINE MOUSE IN NORTHERN NEW YORK.—On the 13th of June, 1884, at my home in Lewis county, New York, I caught a female pine mouse (*Arvicola pinetorum* LeConte). It was taken in a trap baited with beechnuts and set for the red-backed wood mouse (*Evotomys rutilus* Gapperi) at the roots of a maple in the border of a hard-wood forest. This species has not been previously recorded from so far north in the Eastern States, Massachusetts having been given as the limit of its northern range. Its rarity appears from the fact that this is the only individual ever procured here, while of the common meadow mouse (*Arvicola riparius*) I have taken several hundred specimens.

[1] This was suspected by Professor Baird nearly thirty years ago, for he said: "I am not prepared to admit the *Scalops æneus* of Mr. Cassin as distinct from *S. townsendii*. The smaller size would belong to a young specimen, and the peculiar combination of the brassy color with the black nails and feet might be the natural result of long immersion of the animal in alcohol." (Pacific Railroad Reports, Vol. VIII, 1857, p. 67.)

The pine mouse is said to be common on Long Island, and Audubon and Bachman speak of it as "quite abundant * * * in the immediate vicinity of New York."[1]—*C. Hart Merriam, M. D.*

CAPTURE OF THE PINE MOUSE AT SING SING, NEW YORK.—Until the present year we have never detected the pine mouse (*Arvicola pinetorum*) in this locality. On Feb. 12th, 1885, a specimen was picked up on the road-side, dropped probably by some bird of prey as shown by the claw marks on it. A week later, we had occasion to examine a hole in an old apple tree occupied by a screech owl (*Scops asio*). Besides specimens of the mole (*Scalops aquaticus*), and meadow mice (*Arvicola riparius*), we found four pine mice, two of which were uninjured. The only other specimen noted was shot March 3d, while running on top of the snow.—*A. K. Fisher, M. D., Sing Sing, New York.*

A NEW GENUS AND SPECIES OF SHREW.—In the Transactions of the Linnæan Society of New York, Dr. C. Hart Merriam describes and figures a shrew of more than ordinary interest captured by Captain Bendire near Fort Klamath. It is one of the largest of the shrews, is the type of a new genus, and is called *Atophyrax bendirii*. Bendire's shrew differs from all existing genera in external, cranial and dental characters. It has affinities with both Sorex and Neosorex, and is in some respects intermediate between them, though in some respects it passes Neosorex in the direction away from Sorex. It also possesses characters of its own not found in either of these genera. Dr. Merriam thinks that it in common with Neosorex was early differentiated from a group of thirty-two toothed shrews of which the genus Sorex contains the near-living allies. "Having abandoned a fossorial for, in the one case a natatory, in the other a paludal habit, Neosorex and Atophyrax doubtless began to diverge in the same direction, their distinctive features having been developed and intensified as their peculiarities of habit became fixed—each retaining in different degrees of modification certain characteristics of the original stock."

HARELDA GLACIALIS AT NEW ORLEANS.—An old male in winter plumage was shot on Lake Catherine, a salt water bay a short distance from the city, on Feb. 28th, 1885. Andubon says that this duck comes down as far south as this latitude, but it is the first specimen I have seen shot in this neighborhood.

The skin of this bird is in my possession.—*G. Kohn, 14 Carondelet St., New Orleans.*

ORIGIN OF THE AMERICAN VARIETIES OF THE DOG.—The impression that the domestic dog of the old world has descended from wild species distinct from the wolf may be well founded, but in America the evidence tends to prove that the Eskimo, and other

[1] Quadrupeds of North America, Vol. II, 1851, p. 219.

domestic varieties of dogs were domesticated by the aborigines and used by them long anterior to the discovery of the continent by the Europeans, the varieties in question originating from the gray wolf or prairie wolf. First as to the Eskimo dog. From the following extract from Frobisher it appears evident that the Eskimo had the present breed of domestic dogs long anterior to the year 1577. Frobisher's account of the Eskimo themselves is, so far as we know, the first extant, and is full and characteristic. After describing the natives he goes on to say: "They frank or keepe certaine dogs not much much vnlike wolues, which they yoke togither, as we do oxen and horses, to a sled or traile: and so carry their necessaries over the yce and snow from place to place: as the captive, whom we haue, made perfect signes. And when those dogs are not apt for the same vse: or when with hunger they are constrained for lack of other vituals, they eate them: so that they are as needful for them in respect of their bignesse, as our oxen are for vs." [1]

Regarding the Eskimo dog, Richardson remarks in his Fauna Boreali-Americana, p. 75: "The great resemblance which the domestic dogs of the aboriginal tribes of America bear to the wolves of the same country, was remarked by the earliest settlers from Europe (Smith's Virginia), and has induced some naturalists of much observation to consider them to be nearly half-tamed wolves (Kalm). Without entering at all into the question of the origin of the domestic dog, I may state that the resemblance between the wolves and the dogs of those Indian nations, who still preserve their ancient mode of life, continues to be very remarkable, and it is nowhere more so, than at the very northern extremity of the continent, the Esquimaux dogs being not only extremely like the gray wolves of the Arctic circle, in form and color, but also nearly equaling them in size. The dog has generally a shorter tail than the wolf, and carries it more frequently curled over the hip, but the latter practice is not totally unknown to the wolf. * * * I have, however, seen a family of wolves playing together, occasionally carry their tail curled upwards."

The Hare Indian dog is also supposed to be a domesticated race of the prairie dog, as shown by the following extract from Richardson's Fauna Boreali-Americana:

"*Canis familiaris* var. *B. lagopus*, Hare Indian dog. This variety of dog is cultivated at present, so far as I know, only by the Hare Indians and other tribes that frequent the border of Great Bear lake and the banks of the Mackenzie. It is used by them solely in the chase, being too small to be useful as a beast of burden or draught." It is smaller than the prairie wolf. "On comparing live specimens I could detect no marked difference in form (except the smallness of its cranium), nor in fineness of the fur,

[1] The second voyage of Master Martin Frobisher, 1577. Written by Master Dionise Settle, Hakluyt, Vol. III, new edition, London, 1810, p. 62.

and arrangement of its spots of color. * * * It, in fact, bears the same relation to the prairie wolf that the Esquimaux dog does to the great gray wolf."

Another variety of Indian dog is Richardson's *Canis familiaris* var. *D. novæcaledoniæ*, Carrier Indian dog. The Attnah or Carrier Indians of New Caledonia possess a variety of dog which differs from the other northern races. "It was the size of a large turnspit dog and had somewhat of the same form of body; but it had straight legs, and its erect ears gave it a different physiognomy."

The spitz dog, Mr. J. A. Allen informs us, is with little doubt a domesticated subarctic variety of the prairie wolf.

Sir John Richardson in the Appendix to Back's Narrative, Paris, 1836, p. 256, remarks: "Indeed, the wolves and the domestic dogs of the fur countries are so like each other, that it is not easy to distinguish them at a small distance; the want of strength and courage of the former being the principal difference. The offspring of the wolf and Indian dog are prolific, and are prized by the voyagers as beasts of draught, being stronger than the ordinary dog."

The origin of the ordinary Indian dog of North America is obscure, but Richardson, who names it *Canis familiaris* var. *C. canadensis*, North American dog, throws much light on its origin:

"By the above title I wish to designate the kind of dog which is most generally cultivated by the native tribes of Canada, and the Hudson Bay countries. It is intermediate in size and form between the two preceding varieties, and by those who consider the domestic races of dog to be derived from wild animals, this might be termed the offspring of a cross between the prairie and gray wolves. * * * The fur of the North American dog is similar to that of the Eskimaux breed, and of the wolves. The prevailing colors are black and gray, mixed with white. Some of them are entirely black. * * *" He quotes from Theodat's "Canada," written in 1630, to show that of the early period, and "perhaps even before the arrival of Europeans, they formed an esteemed article of food of the natives." Confirmatory of the theory of the Pre-columbian origin of the Indian dog may be cited the following entract from Hakluyt's Voyages regarding the Indian dogs seen on Cape Breton island, p. 1593:

"Here divers of our men went on land upon the very cape, where, at their arivall they found the spittes of Oke of the savages which had roasted meate a little before. And as they viewed the countrey they sawe divers beastes and foules, as blacke foxes, deere, otters, great foules with red legges, pengwyns, and certain others. * * * Thereupon nine or tenne of his fellows running right vp over the bushes with great agilitie and swiftness came towards vs with white staues in their hands like halfe pikes, and their dogges of colour blacke not so bigge as a grayhounde

followed them at the heeles ; but wee retired vnto our boate without any hurt at all received." (The voyage of the ship called the *Marigold* of M. Hill of Redrise vnto Cape Breton and beyond to the latitude of 44 degrees and an half, 1593, written by Richard Fisher Master Hilles man of Redriffe. Hacluyt, III, 239.)

It is probably this variety, the bones of which have been found by Dr. J. Wyman, in the shell heaps of Casco bay, Maine.

"The presence of the bones of the *dog* might be accounted for on the score of its being a domesticated animal, but the fact that they were not only found mingled with those of the edible kinds, but like them were broken up, suggests the probability of their having been used as food. We have not seen it mentioned, however, by any of the earlier writers, that such was the case along the coast, though it appears to have been otherwise with regard to some of the interior tribes, as the Hurons. With them, game being scarce, "venison was a luxury found only at feasts, and dog flesh was in high esteem." * * * A whole left half of the lower jaw of a *wolf* was found at Mount Desert, measuring 7.5 inches in length, making a strong contrast in size with a similar half from a dog found at Crouch's cove. This was more curved, and had a length of a little less than five inches." (AMER. NAT., I, 576, Jan. 1868.)

It is possible that the Newfoundland dog was indigenous on that island, and also an offshoot of the gray wolf, allied to the Eskimo. In their "Newfoundland," Messrs Hatton and Harvey say that there are few fine specimens of the world-renowned "Newfoundland dog" to be met with now in the island from which it derived its name. "The origin of this fine breed is lost in obscurity. It is doubtful whether the aborigines possessed the dog at all ; and it is highly improbable that the Newfoundland dog is indigenous. Some happy crossing of breeds may have produced it here. The old settlers say that the ancient genuine breed consisted of a dog about twenty-six inches high, with black ticked body, gray muzzle, and gray or white stockinged legs, with deer claws behind." Judicious treatment has greatly improved the breed. "Their color is white with black patches, curly coats, noble heads and powerful frames. The favorite Newfoundland dog at present is entirely black, of large size, from twenty-six to thirty inches in height, remarkable for his majestic appearance. It is now generally admitted that there are two distinct types of the Newfoundland dog, one considerably larger than the other, and reckoned as the true breed; the other being named the Labrador, or St. John's, or Lesser Newfoundland. The latter is chiefly found in Labrador, and specimens are also to be met with in Newfoundland," pp. 194–195.

Regarding the dogs of the Mexican Indians, Nadaillac says in his Prehistoric America: "The European dog, our faithful com-

panion, also appears to have been a stranger to them.[1] His place was very inadequately filled by the coyote,[2] or prairie wolf, which they kept in captivity and had succeeded in taming to a certain extent."

In a recent visit to Mexico, not only along the railroads, but in the course of a stage ride of about five hundred miles through provincial Mexico, from Saltillo to San Miguel, we were struck by the resemblance of the dogs to the coyote; there can be little doubt but that they are the descendants of a race which sprang from the partly tamed coyote of the ancient Mexican Indians. At one village, Montezuma, we saw a hairless or Carib dog as we supposed it to be; similar dogs are sometimes seen in the United States.

Finally that the domestic dog and gray as well as the prairie wolf will hybridize has been well established.

Dr. Coues has observed hybrids between the coyote and domestic dog on the Upper Missouri (see the AMERICAN NATURALIST, 1873, p. 385). To this we may add our own observations made at Fort Claggett on the Upper Missouri in June, 1877. We then were much struck by the wolf-like appearance of the dogs about an encampment of Crow Indians, as well as the fort; they were of the size and color of the coyote, but less hairy and with a less bushy tail. They were much like those lately observed in Mexico, and I have never seen such dogs elsewhere. Their color was a whitish tawny, like that of the Eskimo dog.

Confirmatory of these observations is the following note by J. L. Wortman in the report of the Geological Survey of Indiana for 1884: "During extended travel in Western U. S. my experience has been the same as that recorded by Dr. Coues. It is by no means uncommon to find mongrel dogs among many of the Western Indian tribes, notably among Umatillas, Bannocks, Shoshones, Arrapahoes, Crows, Sioux, which to one familiar with the color, physiognomy and habits of the coyote, have every appearance of blood relationship, if not, in many cases, this animal itself in a state of semi-domestication. The free inter-breeding of these animals, with a perfectly fertile product, has been so often repeated to me by thoroughly reliable authorities and whose opportunities for observation were ample, that I feel perfectly willing to accept Dr. Coues' statement."

To these statements may be added that of Mr. Milton P.

[1] Certain kinds of dogs were, however, domesticated in America. They were called *Xulos* in Nicaragua, *Tzomes* in Yucatan, and *Techichis* in Mexico. These were considered to afford very delicate food after having been castrated and fattened.

[2] *Canis latrans* Baird. In a description of Virginia, published in 1649, we read: "The wolf of Carolina is the dog of the woods. The Indians had no other curs before the Christians came amongst them. They are made domestic. They go in great droves in the night to hunt deer, which they do as well as the best pack of hounds."

Pierce, published in *Forest and Stream* for June 25, 1885, as follows: "Hybrid wolves have always been very common along our Western frontiers. I have seen several of them, sired both by dogs and wolves, and all I have seen have resembled wolves rather than dogs." It is to be hoped that our mammalogists may collect and examine this subject, particularly the skulls and skins of numerous specimens both of dogs and wolves and of the hybrids between them. Farther observations are also needed as to the fertility of the hybrids.—*A. S. Packard.*

Zoological News.—*General.*—MM. G. Pouchet and T. de Guerne have examined the organisms taken by net in the Baltic, in 1884, by the Prince of Monaco. The region fished over extended from 54° 59′ N. lat., at 14° 48′ long. W. of Paris, to the end of the Gulf of Finland. It seems that the pelagic fauna of this gulf resembles that of the great lakes of Europe, as made known by Forel, Lilljeborg, and others. Certain species of Cladocera are very common, and, as in the lakes, are attacked by parasitic cryptogams. Numerous Infusoria and rotifers of the genus Anuræa augment the resemblance to the fauna of the Scandinavian lakes. The central basin of the Baltic offers characters transitional between those of fresh and salt water.

Sponges.—Mr. H. I. Carter (*Ann. and Mag. Nat. Hist.*, February, March and April, 1885), describes numerous new species of sponges from the neighborhood of Port Philip Heads, South Australia, and also contributes a note upon the mode of circulation in the Spongida.

Cœlenterates.—Professor Allman recently read before the Linnæan Society descriptions of thirty-eight new species of hydroids, belonging to twelve genera. The plumularian genus Podocladium is very remarkable, not only by the possession of both fixed and movable nematophores, but by the fact that every hydrocladium is supported on a cylindrical jointed peduncle. *Thuiaria heteromorpha* combines upon one hydrophyton no less than three morphological types, yet Mr. Allman regards the generic position as determined by the one which most decidedly prevails in it.

Mollusks.—M. Lacaze Duthiers has instituted a comparison between the ordinary slugs and the genus Testacella. Especially he has compared the nervous systems and traced out the homologies of the nerves. In the slug the rudimentary mantle is situated upon the back, while Testacella carries its small shell and underlying mantle on the under side of its posterior extremity, yet the innervation of these parts is the same. The Testacella is not a vegetable eater, but searches for and devours worms by following them into their holes, and M. Lacaze Duthiers believes it to be a slug gradually altered and transmitting its altered characters by heredity.——W. E. Hoyle (*Ann. and Mag. Nat. Hist.*, March,

1885) gives the diagnoses of twenty species of Cephalopoda collected during the cruise of the *Challenger*. The new kinds are *Octopus verrucasus*, the minute hectocotylus of which is present, *O. boscil*, var. *pallida*, *O. australis*, *O. hongkongensis* *O. tonganus*, hectocotylus present, *O. vitiensis*, *O. duplex*, and four other species of Octopus besides *O. januarii*, Steenstrup M. S.; *Eledone rotunda* and *E. brevis*, *Japatella* (nov. gen.) *prismatica* and *diaphana*; *Cirrolentha magna*, *meangensis*, and *pacifica*, and *Ampliobrebus pelagicus*, nov. gen. et sp.——Mr. A. H. Cooke republishes, with additions and corrections, a list of the testaceous mollusks obtained by R. MacAndrew in the Gulf of Suez. Of nineteen species of Cypræa found, nine occur at the Sandwich islands, six in Japan, eight in Australia and five at Natal, and of seven species of Triton two are common to the Sandwich islands, two to Japan and one to Australia.

Crustacea.—E. J. Miers (*Ann. and Mag. Nat. Hist.*, January, 1885) gives a synopsis of the species of Micippa and Paramicippa. He allows six species of the former genus (*M. cristata*, *mascarenica*, *philyra*, *spinosa*, *curtispina*, and *thalia*), all of which seem to be restricted to the shallower waters of the Indo-Pacific, and only by one species of the latter genus (*P. tuberculosa*).——In the same issue of the same periodical the Rev. Thomas R. R. Stebbing describes *Cyproidia damnoniensis*, a new English amphipod. ——M. W. Czerniawsky has published at Kharkoff a work on the littoral decapodous Crustacea of the Black sea. The number of Pontic decapods has been increased by twenty, thus reaching forty-eight species. The author arrrives at some interesting conclusions as to genealogy. The nine different stages of the metamorphosis of Carcinus are, he says, a repetition of its genealogy; all three species of Astacus found in the Ponto-caspian fauna are maritime forms which have immigrated into sweet water, and even *Astacus pachypus* of the mountain lake Abrau is the remainder of a maritime fauna, so also Thelphusa, which has gigantic representatives in the South Caspian. *Eriphia spinifrons* and *Carcinas mœnas* reach a very large size on the shores of the Crimea and at Odessa. While most crabs reach their fullest development only in very salt and warm water, others reach the same size under reverse conditions. The decapods of the Sea of Azov have not yet been explored.

Fishes.—Professor Fritsch has been induced by the examination of the peculiar flap-like appendages of Lophius to search for corresponding peculiarities in the nervous system, peculiarities which he soon discovered in the medulla oblongata. On the posterior side of the medulla, quite superficially situated, he found a group of huge ganglion-cells, such as had hitherto only been found in Malapterurus. While the latter fish had but two such cells, Lophius had a larger number.

Reptiles and Batrachians.—G. A. Boulenger gives a list of thirty-one reptiles and sixteen batrachians from the province of Rio Grande do Sul, Brazil, collected by Dr. H. von Ihering. The new species are *Enyalius iheringii*, and *Liolæmus occipitalis* (Lacertilia), and *Coronetta iheringii*.

EMBRYOLOGY.[1]

ON THE AVAILABILITY OF EMBRYOLOGICAL CHARACTERS IN THE CLASSIFICATION OF THE CHORDATA [*concluded*].—1. The lowest major subdivision of the Endocyemate subphylum embraces forms in which the ovum is invested by a zona radiata, external to which comes an additional investment of albuminous matter secreted by the oviduct, this albuminous envelope being usually in turn covered by a fibrous membrane immediately overlaid by a porous, more or less calcareous shell, also secreted by the oviduct. Chalazæ are often developed. The cleavage is partial, the germinal matter, as a rule, forms but an insignificant part of the whole ovum, and is aggregated at one pole of the latter as a blastodisk. The blastodermic vesicle is developed from the blastodisk by epiboly upon the vitelline mass, which is finally included so as to occupy a ventral position in the vesicle. Development is at most viviparous only during the very earliest stages or while the ovum is passing through the oviducts, or more or less entirely oviparous, or quite ovoviparous. The allantois is greatly developed, but never associated in the development of a true placenta, though it is usually respiratory in function.

Under this definition the three following groups seem to be appropriately included:

a. Ova buried in the earth or sand by the parent, and left to be incubated by the heat of the sun. Some species ovoviviparous. Reptilia.

b. Ova incubated by the parent in a nest specially constructed for the purpose. Aves.

c. Ova incubated by parent in an abdominal marsupium or in a nest at the end of a burrow. Recently hatched young nourished by the parent for a time upon milk secreted by mammary glands. No functional uterus. Ornithodelphia.

It may also be noted that with group *b* the distinctly warm-blooded series of the Chordata begins. The relatively high temp rature of the body of the adult plays an important part in incub^{e}tion or in accelerating metabolism in the embryo. The prec^{a}ding three groups, on account of the many features of resemb^{e}ance and reptilian traits possessed in common (group *c* being alparently affiliated with the extinct Theromorpha of Cope), mpght be considered to form a series to be called Paratheria.

12. The highest major subdivision of the Endocyemate sub-

[1] Edited by JOHN A RYDER, Smithsonian Institution, Washington, D. C.

phylum embraces the eutherian type, or the viviparous Mammalia, in which the ovum is invested only by a zona radiata. The ovum also becomes more or less covered over by reflections of the uterine epithelium, or processes from the surface of the ovum are received into furrows or pits of the mucous surface of the uterine cavity, in which embryonic development proceeds more or less nearly to completion, and where the developing embryo acquires nourishment after the manner of a parasitic organism. The cleavage of the egg is total, and leads to the formation of a hollow, rapidly-enlarging, blastodermic vesicle or blastula, in which no vitelline matter or deutoplasm lies free in the ventral pole or yolk sack. This group is characterized by its viviparity, the development of a placenta and the possession of a functional uterus; it has obviously descended from one of the preceding groups which had ova provided with a large yolk, the yolk having gradually atrophied or failed to develop as the peculiar viviparous mode of development became more and more pronounced.

a. The lowest division of the Eutheria would be separated from the highest, on embryological grounds, by the circumstance that the vascular system of the fœtus is brought into relation with the maternal vessels by means of the vessels of the yolk sack (Owen, Osborn). Or by means of pseudopodal processes of the cells forming the yolk sack, Phascolarctos (Caldwell). Allantois more or less rudimentary. Didelphia.

b. In the highest division of the Eutheria the vascular system of the fœtus is brought into relation with the maternal vessels by means of the allantois, which is concerned in forming a villous or spongy vascular mass known as the placenta. Monodelphia.

In the present state of our knowledge it seems premature to attempt a definition of the orders of the Monodelphia upon the basis of placental characters alone, as the following scheme seems to show. It is difficult, however, not to believe that the non-deciduate and diffuse type of placenta is the most primitive, and that then follows the deciduate zonary, and finally as the most specialized the deciduate discoidal. This seems to me must have been the order of evolution of the forms of the placenta, for the reason that in the Paratherian, Endocyemate form, from which the Eutheria have undoubtedly been developed, the vascular allantois invests the whole embryo. In this succession the orders of the Monodelphia will therefore be here arranged as nearly as possible:

aa. Placenta non-deciduate, diffuse or cotyledonary. Cetacea, Sirenia, Ungulata.

bb. Placenta non-deciduate, diffuse (Manis); or non-deciduate? nearly zonary (Orycteropus); or non-deciduate, zonary (Dasypus novemcinctus); or deciduate discoidal (Dasypus sp., Cholœpus). Edentata.

cc. Placenta deciduate, zonary. Carnivora, Proboscidea, Hyracoidea.

dd. Placenta deciduate, discoidal or exceptionally non-deciduate and diffuse as in the Lemuridæ. Rodentia, Insectivora, Cheiroptera, Primates.

Much remains to be learned of the earliest stages of the formation of the placenta, especially in the Primates. In Talpa, Heape has found a rudimentary "träger" or suspensor developed. In some of the Rodentia the embryonic mass is precociously invaginated into the blastocœl, and the amniotic cavity is formed in the most extraordinary manner, or by a sort of vacuolization or accumulation of fluid (liquor amnii) in the midst of the mass of undifferentiated embryonic cells. This occurs in Mus, Arvicola and Cavia, according to Selenka. In these forms the blastodermic vesicle also becomes adherent to the uterine epithelium at a very early stage, and the suspensor is very markedly developed in the three forms mentioned. The precocious invagination of the undifferentiated embryonic mass of cells into the blastocœl leads, in the Rodentia, to an apparent inversion of the embryonic layers. These forms have therefore attained the most specialized mode of development known amongst Mammalia, so that, judged by the standard of embryology alone, they would rank higher than the Primates.

The foregoing scheme illustrates in a very striking manner the way in which complication after complication has been added to the developing germ, starting with a simple blastula developed by total cleavage in Branchiostoma; the next step in the progress of embryonic specialization is that seen in the amphibian and marsipobranchian embryo, in which a distinct neurenteric canal is also developed, and in which the neurenteron is continued into the enteric cavity, which itself traverses the segmented vitelline mass longitudinally along its upper half. In the next grade of specialization, or that represented by the Ichthyes of this arrangement, the vitellus remains unsegmented for a long time, and is practically excluded from sharing in the formation of the enteric walls, but the embryo is sessile in the greater number of species embraced in this series, and while only a portion of the blastodermic area leads to the differentiation of an embryo, no part of the ectoblast is ever so folded off to form provisional organs such as the amnion and false amnion, which serve only a temporary purpose, to be finally cast off when they have subserved their function in the development of the embryo, as in the highest forms. These latter, or the endocyemate types, as a rule, develop a blastoderm with a relatively very large area, but only a very small portion of the ectoblast ever takes a permanent share in the formation of the body of the embryo, the remainder of this layer being entirely deciduous. In the Paratherian series of endocyemate types, viz., Reptilia, Aves and Ornithodelphia, there is a large yolk developed, which seems to have determined the development of the hollow yolkless blastophere of the Eutheria, in which, how-

ever, there is a manifest tendency for that structure to increase rapidly in size owing to the imbibition of fluid with which the blastocœl becomes more and more distended, this increase in size at the same time being aided by the division of the cells entering into the formation of the walls of the blastocœl. The greater part of the walls of this vesicle are finally metamorphosed by a process of folding off and ingrowth of the embryo into the vesicle by invagination, into a respiratory apparatus and secondary system of envelopes, a portion of which also takes part more or less extensively in the absorption of pabulum from the surrounding uterine surfaces which may be more or less completely reflected around the embryo and its vesicle, to be finally cast off at birth together with those parts of the vesicle derived from the ectoblast, which are also deciduous. The vesicle also tends, with a few exceptions, to thrust out hollow villi, which dip into pits in the uterine mucosa. These may arise locally or all over the vesicle, and reach their fullest development when the chorion has been formed, when the greater part of the surface of the vesicle acquires a shaggy covering of villi, into which vascular loops from the allantois are insinuated, over a restricted area internally or over its whole surface. These then become more or less completely insinuated into vascular uterine crypts into the constitution of which a decidua may or may not enter.

It will, I think, be obvious to any one, that if an oviparous paratherian form were to have the eggs which it produces so modified as to lose the shell, yolk and albuminous and fibrous envelopes, leaving only the naked endocyemate ovum to be retained near the outlet of the oviduct, the wall of which would then become thickened so as to form a specialized uterine dilatation, the conditions for a realization of the eutherian mode of viviparous development would be present. In this way, no doubt, the peculiarly specialized mode of mammalian development arose.

Objections may be urged against the position I have assigned to the Amphibia and Marsipobranchii as well as to the names given to the groups, and to the stress laid upon the physiological aspects of development and their importance not only in taxonomy but also in tracing the mode of the evolution of particular grades of development.

The form of the placenta seems to depend upon several factors: (1) The early or late attachment of the blastodermic vesicle to the uterine walls; (2) the early or late invagination of the embryo or embryonic mass; (3) the extent of subzonal membrane covered by the allantois, and the mode in which the latter is extended; (4) the form of the uterine cavity in which the blastodermic vesicle is lodged, whether tubular, bicorned or irregular; (5) the position and disposition of the uterine mucosa which is brought into relation with the placenta, whether it lines the conical or tubular

cornua, sides or fundus of the uterus; (6) the disposition of the crypts, fossæ, pits or folds of the uterine mucosa; (7) the arrangement and disposition of uterine vessels from which the maternal tufts or villi are fed and derived. These influences are largely mechanical in character, and like the influence exerted by the vitellus, lead, in certain cases, to very remarkable modifications of embryonic development.

The foregoing scheme deals more especially with the evolution of the various higher types of development, and if the way in which these have grown out of the lower ones has been made a little less obscure than hitherto, my object in writing this will have been attained. The manner in which placentation has been modified is also a fruitful subject for farther investigation, not less so, in fact, than the question as to how the amnion arose. The facts of embryology tend to show that the amnion is the result, as stated above, of the gradual invagination of the embryo into the blastodermic vesicle. The invagination begins at the head end of the embryo; the amnion, as is well known, always developing its first traces at the cephalic end of the embryonic disk. It is also probable that the cavity of the false amnion is the homologue of the cleavage cavity of certain of the lower forms.—*John A. Ryder.*

PHYSIOLOGY.[1]

A Contribution to the Knowledge of Pepsin[2].—Sundberg has hit upon a method for preparing pepsin, which gives results better than those obtained by Brücke's method.

Calves' stomachs are taken, the pyloric portion removedand the remainder of the mucous membrane carefully washed with water. The superficial portion of the membrane is then scraped off with a watch glass, and the substance thus obtained is ground up with a weighed quantity of salt. Enough water is added to this to make a saturated solution of salt. After standing 24–72 hours this was filtered and the Na Cl removed by dialysis. The dialysed liquid contained very little albumin and had a very powerful peptic action. It was further purified by being kept at 40° C. for some time to destroy the rennet ferment, and was then allowed to digest itself for one or two weeks, until all the albumin was converted into peptone. To this liquid chloride of calcium and acid sodium phosphate were added, and the liquid made weakly alkaline by ammonia; the resulting precipitate of calcium phosphate carried down the pepsin with it. The precipitate was collected in a filter, thoroughly washed with water and dissolved in as small a quantity as possible of five per cent HCl. This solution was then thoroughly dialysed. The liquor obtained finally, when brought to the proper degree of acidity, digested very ac-

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Mich.
[2] Zeitsch. f. physiol. Chemis. 9, 319. Sundberg.

tively. With tannic acid, mercuric chloride, iodine, platinum chloride, and lead acetate it gave no albumin reaction whatever. The only reagent that affected it was absolute alcohol. When the pepsin solution was added to five or six times its volume of alcohol a slight white precipitate occurred. This, when burnt on platinum foil, gave the well-known odor of burning nitrogenous matter. The author concludes, that while pepsin is a nitrogenous body, it is not albuminous.

CONTRIBUTION TO THE KNOWLEDGE OF BILE CAPILLARIES[1].—Miura has discovered a modification of the gold method by which the bile capillaries can be stained, giving a simpler means for their study than the method of artificial injection usually employed. Pieces of liver kept in Müller's liquid for two to five days are washed in water for several hours, and then transferred to a fifteen per cent solution of glucose for 2–3 hours. They are then placed in a 0.1 to 0.2 per cent solution of the double chloride of gold and sodium for two or three days, and again placed in the glucose solution and allowed to reduce for two or three days. Sections are cut by means of a freezing microtome.

Miura has endeavored to settle two questions by this method. 1. Do the Kupffer vacuoles really exist in the liver cells as the beginning of the bile capillaries? His method gives no indication at all of these vacuoles, and he infers that, as usually found, they are artificial products caused by the pressure used in injection. 2. Have the bile capillaries walls? When their sections were traced out he quite frequently found places in which the broken ends of the capillaries projected beyond the cells, or where they formed a bridge passing between two cells at a point where they had been separated by the tracing needle. He concludes from these appearances that the capillaries have walls of their own.

THE MICROSCOPIC APPEARANCE OF STRIPED MUSCLE DURING CONTRACTION[2].—The author investigated the muscle when thrown into maximal tetanus, and when the tetanus was not maximal. The muscle was stimulated by induction shocks and killed during contraction by osmic acid or alcohol.

The muscle of maximal tetanus when thus treated showed certain bands (contraction bands) running across the fibers, representing, doubtless, Krause's membrane of the resting muscle. Between these contraction bands the fiber was swollen out, giving a convex border. Examined by polarized light, the whole substance of the fiber is found to be doubly refracting. The contraction band representing Krause's membrane undergoes no change during contraction; it appears, in the author's opinion, to play the passive part of giving a fixed support from the shortening. The portions in between the contraction bands, also doubly refracting,

[1] Virchow's Archiv., 99–512. Dr. Miura.
[2] Du Bois Reymond Archiv., 1885. S. 150. Dr. Nickolaides.

represent the dim bands of the resting muscle, while the singly refracting light bands of the resting muscle disappear completely during maximal tetanus, being absorbed apparently by the doubly refracting substance of the dim band. When the tetanus was not maximal some of the singly refracting substance was still found in the contracted fiber.

The results given go to support Englemann's theory of muscle contraction, according to which the shortening of the contracted fiber is owing to the absorption by imbibition of the singly refracting substance of certain ultimate elements in the doubly refracting substance, thus becoming spherical during the act and decreasing in diameter.

PSYCHOLOGY.

DO MONKEYS INVARIABLY LEARN by EXPERIENCE?—Some time ago I read a statement to the effect that monkeys were unable to learn by experience, a particular in which they were said to differ from cats. The experiment suggested was to show the animal its reflection in a mirror, and after a time to repeat the process and observe whether it would be deceived a second time. I have never had the opportunity to try the experiment on monkeys, though I am told, on tolerably good authority, that a monkey can never satisfy itself that there is not another monkey behind the glass. But my acquaintance with cats is somewhat larger, and I find that, after once thoroughly investigating the subject, a cat which has reached an age of discretion takes no further interest in its own reflection. The question in my mind is: if a monkey cannot learn by experience, how can it learn? for it seems to me that almost every means of learning can be reduced to some form of experience, or to something that is practically the same thing.—*W. H. Frost, Brown University.*

A DOG'S STRATEGY.—Our little farm dog "Trip" is of mongrel descent, yet he has more than an ordinary amount of "gray matter" in his brains. He is very sagacious and knowing, and only seems to lack the power of speech to show that sensible ideas run through his head. He likes to leap from a stump into my arms as I am on horseback, and go off with me at a full gallop. One day a lot of pigs got out of their enclosure through a little hole at the apex of an acute angle, or corner, of the fence. This angle widened into the garden where the pigs were not tolerated. As soon as "Trip" saw them he went after them to get them out. They fled before him into this angle and began, slowly, of course, to make their way through. As soon as he saw them all within the angle, he stopped before its widest opening—the base—and intently watching, waited until the last one had crawled back into its proper enclosure. He seemed to understand that if he made a dash at them they would turn around and rush back into

the garden. As soon as they were all in he looked up with a proud and pleased expression, as much as to say: "Isn't that a clever piece of strategy?" We all thought it was. But in numberless incidents of a similar nature "Trip" has proved himself to be a dog of excellent sense and judgment—and often of "rare executive ability."—*Charles Aldrich, Webster City, Iowa, July 11, 1885.*

Do the lower Animals suffer Pain?—As bearing on this question so often asked, we may quote the following statements from Romanes' "Jelly-Fish, Star-Fish and Sea-Urchins": Before any rational scruples can arise with regard to the vivisection of a living organism, some reasonable ground must be shown for supposing that the organism, besides being living, is also capable of suffering. But no such reasonable ground can be shown in the case of these low animals. We only know of such capability in any case through the analogy based upon our own experience, and, if we trust to this analogy, we must conclude that the capability in question vanishes long before we come to animals so low in the scale as the jelly-fish or star-fish. For within the limits of our own organism we have direct evidence that the nervous mechanisms, much more highly elaborated than any of those which we are about to consider, are incapable of suffering. Thus, for instance, when the nervous continuity of the spinal cord is interrupted, so that a stimulus applied to the lower extremities is unable to pass upwards to the brain, the feet will be actively drawn away from a source of irritation without the man being conscious of any pain; the lower nervous centers in the spinal cord respond to the stimulation, but they do so without *feeling* the stimulus. In order to feel there must be consciousness, and, so far as our evidence goes, it appears that consciousness only arises when a nerve-center attains to some such degree of complexity and elaboration as is to be met with in the brain. Whether or not there is a dawning consciousness in any nerve-centers considerably lower in the scale of nervous evolution, is a question which we cannot answer; but we may be quite certain that, if such is the case, the consciousness which is present must be of a commensurately dim and unsuffering kind. Consequently, even on this positive aspect of the question, we may be quite sure that by the time we come to the jelly-fish—where the object of the experiments in the first instance was to obtain evidence of the very existence of nerve-tissue—all questions of pain must have vanished. Whatever opinions, therefore, we may severally entertain on the vexed question of vivisection as a whole, and with whatever feelings we may regard the "blind fury" who, in the person of the modern physiologist, "comes with the abhorred shears and slits the thin-spun life," we should be all agreed that in the case of these animals the life is so very thin-spun that any suggestion of abhorrence is on the face of it absurd.

PSYCHICAL RESEARCH.—The Society of Psychical Research held its third general meeting April 24, in London, to hear the address of Professor Balfour Stewart, F. R. S. This society was founded by Professor Barrett, on the 5th of January, 1882, and formally constituted on the 20th of February of the same year with Professor Henry Sidgwick as president. At present the membership is 586. A kindred society has been recently started in America. Since its commencement the society has issued eight parts of proceedings, and in 1884 commenced the publication of a journal. In the autumn of 1884 a report of the Committee on Theosophical Phenomena was issued for private circulation only. A large number of slips has been printed comprising a selection of the evidence collected in the various departments of inquiry. The greatest liberality on the part of members has enabled the society to do a great deal of printing. Professor Stewart says: "To my mind the evidence already adduced is such as to render highly probable the occasional presence amongst us of something which we may call thought-transference, or more generally telepathy; but it is surely our duty as a society to continue to accumulate evidence until the existence of such a power cannot be controverted. We have not been remiss in this respect, and it will be found from the pages of our proceedings that the main strength of our society has been given to prove the existence of telepathy, in the belief that such a fact well established will not only possess an independent value of its own, but will serve as an admirable basis for further operations.

"It is no doubt quite conceivable that after a quantity of evidence on some subject has been collected the result of its discussion should prove that there is nothing in it worth inquiring into, at least nothing new. But a definite settlement even of a negative character is not without its value, and this can only be obtained as the result of an exhaustive discussion. On the other hand it is conceivable that the result of such a discussion may be the establishment of new facts eminently worthy of record, and the next generation of our society would greatly blame the present if we decline to bring together, examine, and register the cotemporaneous evidence, so as to fit it, if not for our own final discussion, at least for that of those who shall come after us."

Part VII contains the following papers:—

On the telepathic explanation of some so-called spiritualistic phenomena, by Frederick W. H. Myers.

Abstract of the president's opening address at the eleventh general meeting.

M. Richet's Recent Researches in Thought Transference, by O. J. Lodge and Alfred Lodge.

The problems of Hypnotism, by Edmund Gurney.

Part VIII contains:—

Automatic writing, by Frederick W. H. Myers.

Opening address at the thirteenth general meeting by Professor Balfour Stewart.

Notes on the evidence collected by the Society for Phantasms of the dead, by Mrs. H. Sidgwick.

Hallucinations, by Edmund Gurney. .

The calculus of probabilities applied to psychical research, by F. Y. Edgeworth.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL PUBLICATIONS.—The Philosophic Grammar of American Languages as set forth by Wilhelm von Humboldt, with the translation of an unpublished memoir by him on the American verb, by Daniel G. Brinton, A.M., M.D., professor of ethnology and archæology at the American Academy of Sciences, Philadelphia. (Read before the American Philosophical Society, March 20, 1885. Philadelphia, McCalla & Stavely, pp. 50.)

The original MS. of the memoirs is in the Royal Library at Berlin, whence Dr. Brinton obtained a copy. The fundamental ideas of the Philosophical Grammar are these: "The diversity of structure in languages is the necessary condition of the evolution of the human mind." Historic grammar traces the forms of a language; comparative grammar extends the investigation over many dialects or languages; philosophic grammar analyzes the inmost nature of languages with reference to thought. It is contrary to the results of study that the monosyllabic, the holophrastic and the inflectional languages were developed one from another.

On some doubtful or intermediate Articulations; an experiment in phonetics, by Horatio Hale, Esq. London, Harrison & Sons., St. Martin's place. 1845, pp. 243. (Reprinted from Journ. Anthrop. Inst., Feb., 1885.) This essay discusses the mixing of sounds of the same character, *m, b, w; d, l, n, r,* and seeks to account for it. Three theories are proposed; careless utterance; slight anatomical modifications in the speaker; failure of the listener to catch intermediate sounds. Mr. Hale in his paper develops the latter view. There is no doubt, as we have shown in another place, that the philologist must take into consideration the ear and the eye of the receiver of language as well as the vocal organs or the pen of the author. Furthermore, it will be found that all unwritten languages are holophrastic by agglutination or by incorporation, and that monosyllabism and inflection are two effects produced by the reduction of languages to writing. In the examples cited by Mr. Hale the difficulties are remedied instantly, when the missionaries invent an alphabetic system.

American Languages and why we should study them, an address delivered before the Pennsylvania Historical Society, March 9, 1885, by Daniel G. Brinton, professor of ethnology and archæology at the Academy of Natural Sciences, Philadelphia. (Reprinted from the *Penn. Mag. of Hist. and Biog.*) Philadelphia, Lippincott, 1885, pp. 23. In this essay the author main-

[1] Edited by Professor OTIS T. MASON, National Museum, Washington, D. C.

tains that language is almost our only clue to the kinship of American tribes; it discovers the motives of the customs, laws, social life, superstitions and religions of the savages; it discloses the development of his arts; it mirrors the relations of the sexes; it discloses the Indian's psychology; it is the handmaid of historic study. Dr. Brinton closes his address with an earnest appeal for the endowment of research in this direction.

Silex Tertiaires intentionellement Taillés, by G. de Mortillet, *L'Homme*, Paris, Mai, 1885, pp. 289–299, June, 252–262. Two propositions are insisted on in this paper, to wit: The flints of Thenay were wrought by means of fire, and the being who wrought the flints of the Tortonian and the Aquitaine epoch was not man, but an intelligent animal. This animal, more intelligent than the most intelligent recent apes, could not have been man like us, for all the higher animals have been modified since the middle Tertiary. That creature was intermediate between man and ape, à *precursor* of man. M. Mortillet has always given us great pleasure by the energy of his convictions, but in this paper, as in others lately published, there is a spitefulness which mars their effect. It looks very much like dodging the issues when we follow a man like De Quatrefages to the very brink of a conclusion and then shrink back, saying, "The geologists tell us man could not have lived in that time." See also an account of new diggings at Thenay by D'Ault-Dumesnil. *Materiaux*, xix. 241.

Remarks on chipped stone implements, by F. W. Putnam. (From the Bulletin of the Essex Institute, Salem Press.) This communication, made in June 29, 1883, has just appeared, and, if it were not too late to scold, we might complain from absolute knowledge that the author has not told us all he knows about the subject. It is to be hoped that he will put the same nicety of analysis into his technical as into his archæological papers.

Ancient Pottery of the Mississippi valley, by William H. Holmes. (From the Proceedings of the Davenport Academy.) Washington, Judd & Detweiler. The splendid collection o mound-pottery at Davenport is well known. Mr. Holmes signalized three pottery areas; Upper Mississippi, Middle Mississippi, and Lower Mississippi, or Gulf. The great body of the Davenport pottery is from the middle province, and of this there are typical regions. The description of Mr. Holmes covers the finding, age, use, construction, material, color, form, finish, ornamentation. As an artist Mr. Holmes lays himself out on the form and ornamental patterns. Believing with Klemm that every art commences with a natural object, the author has worked out by means of the Davenport pottery the shapes of the vessels and the figures traced upon them.

Prehistoric Dogs, by M. Zabarowski, *Materiaux*, June, 1885, p. 263. From the commencement, or at least the middle of the Quaternary epoch, before any possible effort at domestication, the

dog possessed varieties passing irregularly with crossing of characteristics between the wolves, jackals and foxes. If it can be shown that these varieties were in part expanded over the globe before the intervention of man, it will be settled that it is vain to make the domestic dog-descent from this or that related species.

H. de Charencey. De la conjugaison dans les langues de la famille Maya Quichée. (Extraits du Muséon.) Louvain. The naturalist and the philologist in their classifications accept the same criterium of perfection, it is the principal of the *localization of functions*. The idiom which best distinguishes grammatical categories, not confounding, for example the noun with the verb, has preëminence. In the study of this subject of differentiation we have to examine a language in every particular, great progress being made in one direction, and that ofttimes from outside influences, while the greatest simplicity remains in other particulars. M. Charencey regards monosyllabism as the simplest linguistic form, while agglomeration and inflection are subsequent stages. It seems to be nearer to the truth that monosyllabism and inflection are literary effects in speech both referable to earlier forms, perhaps agglutinative. M. Charencey devotes 130 pages to the discussion of the method in which the Maya language provides for the parts of the verb as known in the French languages.

Bulletin of the Brookville Society of Natural History, No. 1, published by the society. Richmond, J. M. Coe, pp. 45. Mr. E. R. Quick describes the stone mounds on the Whitewater.

Archæological Institute of America. Sixth annual report, 1884–85, presented at the annual meeting of the council of the institute, Boston, May 9, 1885. Cambridge, John Wilson & Son, pp. 48. Among the regulations adopted October 11, 1884, some are of general interest, as for example:

1. The Archæological Institute consists of a number of affiliated societies.

3. The government of the institute shall be vested in a council annually chosen by the members of the affiliated societies. Any local archæological society consisting of not less than ten members of the institute may by vote of the council be affiliated with the institute. There are now three societies of the institute, namely, Boston, Baltimore and New York, and it is hoped by means of this multiplication of affiliated organizations, to increase the usefulness and prove the national character of the institute. Pages 27–40 are devoted mainly to an epitome of the brilliant labors of Adolf Bandelier among the Pueblos and in Mexico. The remainder of the pamphlet is given to a recital of the institute's successes at Assos and in its school of classical studies at Athens.

Notice of some recently discovered effigy mounds, by T. H. Lewis, from *Science*, No. 106, 1885. Mr. Lewis has surveyed twenty-five effigy mounds in Minnesota, one in Iowa and ninety-

six in Wisconsin. Those from Minnesota are illustrated and more fully described.

The American Antiquarian, Vol. VII, No. 3, May, 1885. This number both in its original articles, excepting Mr. Butler's, which ought never to have been written, and in its notes is far above the average. The original papers are as follows:

Stone graves—the work of the Indians, by Cyrus Thomas (third paper).
The chief god of the Algonkins in his character as a cheat and a liar, by Daniel G. Brinton.
Earth and shell mounds on the Atlantic coast of Florida, by Andrew E. Douglass.
The sacrificial stone of San Juan Teotihuacan, by Amos W. Butler.

The Khitan Languages; The Aztec and its migrations, by John Campbell, M.A., Montreal. The purpose of this paper is to connect the Aztecs of Mexico with the Khitans of ancient Syria, the salient modern piers being Japanese, Siberian, Caucasian, Basque.

Laws of phonetic change in the Khitan languages, by the same.

Chief George H. M. Johnson, *Onwanonsyshon*; his life and works among the Six Nations, by Horatio Hale. (Reprint from *Mag. Am. Hist.*, Feb., 1885). With portrait, 131–142. Says Mr. Hale: "This eminent Mohawk chief did more perhaps than any other individual of our time for the elevation and advancement of his kindred of the red race."

THE FUEGIANS.—The average height of twenty men of the Tekeenika or Yaghan race, from Orange bay, was found by M. Hyades to be 1.576 meters, that of twenty females 1.478 meters, a difference of nearly ten centimeters in favor of the men. The tallest man reached 1.660 meters, and the tallest woman 1.577 meters. Although the inhabitants of this district are few in number, the size of the families seems to show that they are not diminishing. The Yaghans of the Beagle river number some 800, and have for neighbors, at the extremity of Beagle strait, the race of the *Ona*, living in the mainland of Terra del Fuego. This race is friendly with the Tekeenika, but those who were seen fled the presence of the white man. The *Ona* are, says M. Hahn, as tall as, or taller than the Patagonians. Five entire bodies (preserved in alcohol) are in the collection brought to Paris by the *Romanche*. These are publicly exhibited by casts, and a hundred casts taken from life, representing every part of the body of individuals of both sexes and all ages, are either exposed publicly, or retained as a special collection open only to naturalists and physicians. Numerous photographs taken from every point of view, some of them representing the natives engaged in the various occupations of their simple life, add value to the collection. Every female of two years of age and upward wears the *machakana*, a small triangular piece of guanaco skin, fastened around the haunches with a plaited band of whalebone fibers. Every Fuegian carries also a mantle, which is but a sim-

ple skin of otter, seal or guanaco, imperfectly serving as a protection from cold. Bracelets, necklaces of shell, etc., are also worn by the women; and the men often wear a band of feathers or down, usually of *Bernicla antarctica*. The only cutting instrument of the Fuegians is a knife of the Mytilus shell fastened to a stone handle with shreds of sealskin. The fishing lines, made of the stems of *Macrocystis pyrifera*, or of whalebone fibers, end in a running knot furnished with a hook made from a feather. Fire is obtained by striking together two pieces of pyrites, and with the spark enkindling a mixture of the down of birds and fine scrapings from Berberis or Drimys. These scrapings are used also as sponges or napkins.

MICROSCOPY.[1]

SOME HISTOLOGICAL METHODS BY DR. C. S. MINOT [*continued*].—*Dripping apparatus for cutting under alcohol.*—We use the form constructed by Dr. W. W. Gannett, as shown in the sketch. A liter bottle is convenient in size; the height of the stand should be such as to bring the end of the dripping tube about one inch above the blade of the microtome knife, on which the alcohol is allowed to fall continuously. To regulate the flow, an eighth inch globe valve is found to be the most convenient.

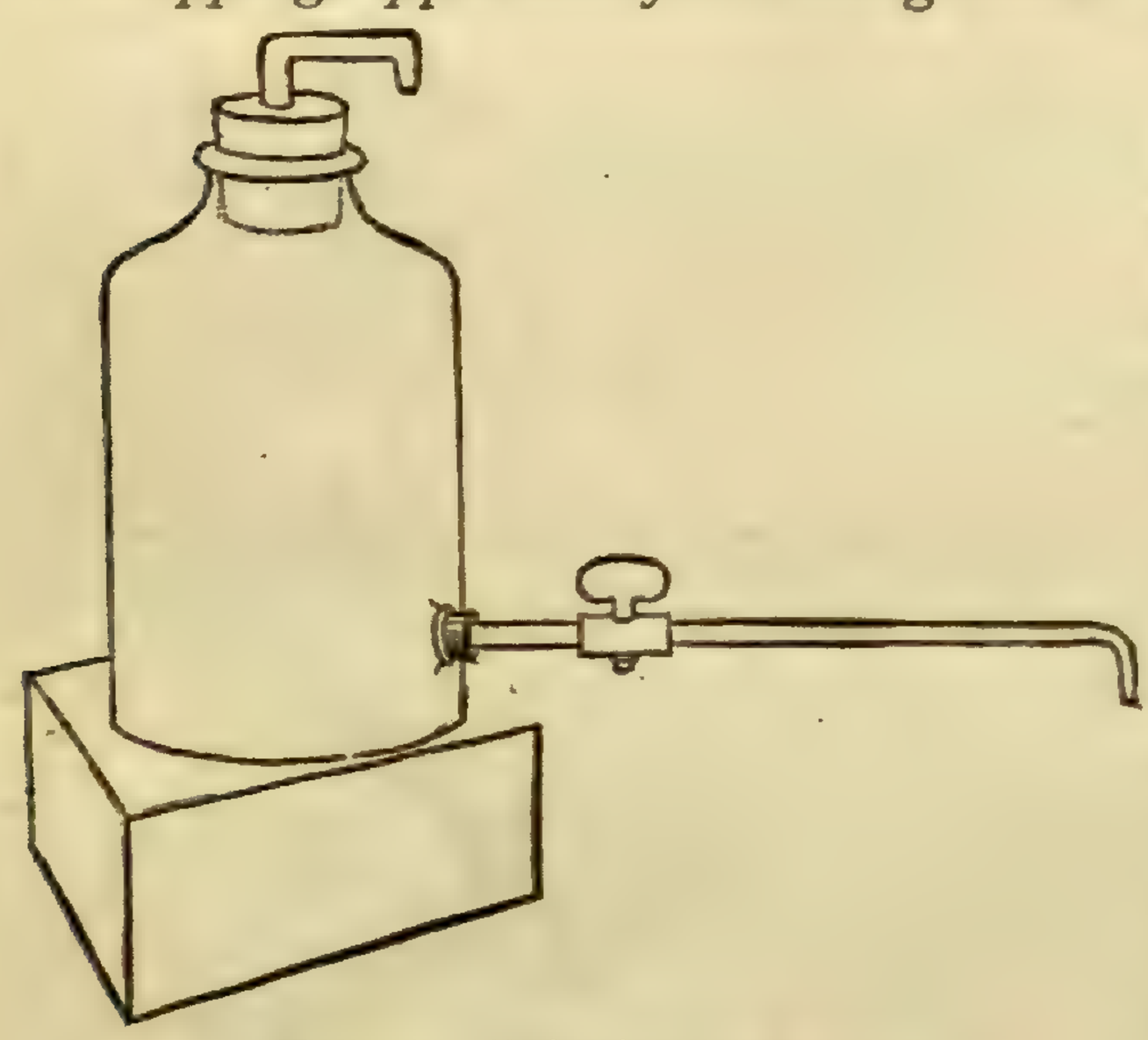

FIG. 1.—Dripping apparatus.

Benzole.—I find replaces xylol perfectly and is much cheaper.

Balsam.—Use filtered Canada balsam diluted with pure benzole.

Alcohol.—I never use absolute alcohol. I have never found any use for which alcohol of ninety-six per cent is not sufficient, and have employed it for many things successfully for which absolute alcohol was stated to be necessary.

Oil—for microtome. After many trials of various oils, we have settled on "*pure paraffine oil, specific gravity 25.*"

Paraffine.—1. Hard commercial paraffine melting at 55°–56° C.

2. Soft "chewing-gum" paraffine melting at 50°.

Twenty parts of 1 + nine parts of 2 makes a good mixture, melting about 55°, and cutting well at 20°–22° C., the ordinary winter room-temperature.

Picric Acid Carmine.—Boil one gramme best powdered carmine with 200 c.c. of water, plus an excess of picric acid, for half an

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

hour. Allow it to stand and cool; decant the clear fluid, add fresh water, and if necessary picric acid; boil, cool and decant; repeat this operation until all the carmine is dissolved. Place the decanted fluid in an evaporating dish, add about one grain thymol and stand in a warm place until the volume is reduced to 25 c.c.; let the solution cool; filter; wash out the residue which should be on the filter with 25 c.c. water; dilute the filtrate solution with 50 c.c. water. By this means a solution ready for use, which will keep indefinitely and contains carmine and picric acid in good proportions, can be prepared with certainty.

It gives a stronger differential coloring than Ranvier's picric carmine, but overstaining must be avoided most carefully; for staining sections two to five minutes are sufficient. The fluid stains connective tissues (fibrous) deep red, striped muscle deep dull red, smooth muscle, blood and horny tissues bright yellow, glands reddish-yellow; with the kidney it gives differentiation of the different portions of the tubules; for the central nervous system it seems to be of little value. If rightly used it gives a sharp nuclear coloring.

If the aqueous solution is evaporated to dryness the residue may be redissolved in alcohol, giving an alcoholic carmine dye. This I have not yet tested sufficiently. Apparently the alcoholic solution will not keep but a few months. The alcoholic solubility of the dye offers the advantage that sections stained in the watery solution can be washed in alcohol directly.

A NEW WATER-BATH.—The following is a description of a water-bath planned by Mr. E. A. Andrews and myself, which has been in use for some time in the biological laboratory of the Johns Hopkins University.

The bath proper consists of a closed copper cylinder twenty-eight inches in diameter and eight inches deep. To the borders of holes cut in the top are soldered four round, flat-bottomed basins, eight inches in diameter and four inches deep, with a distance of two inch-

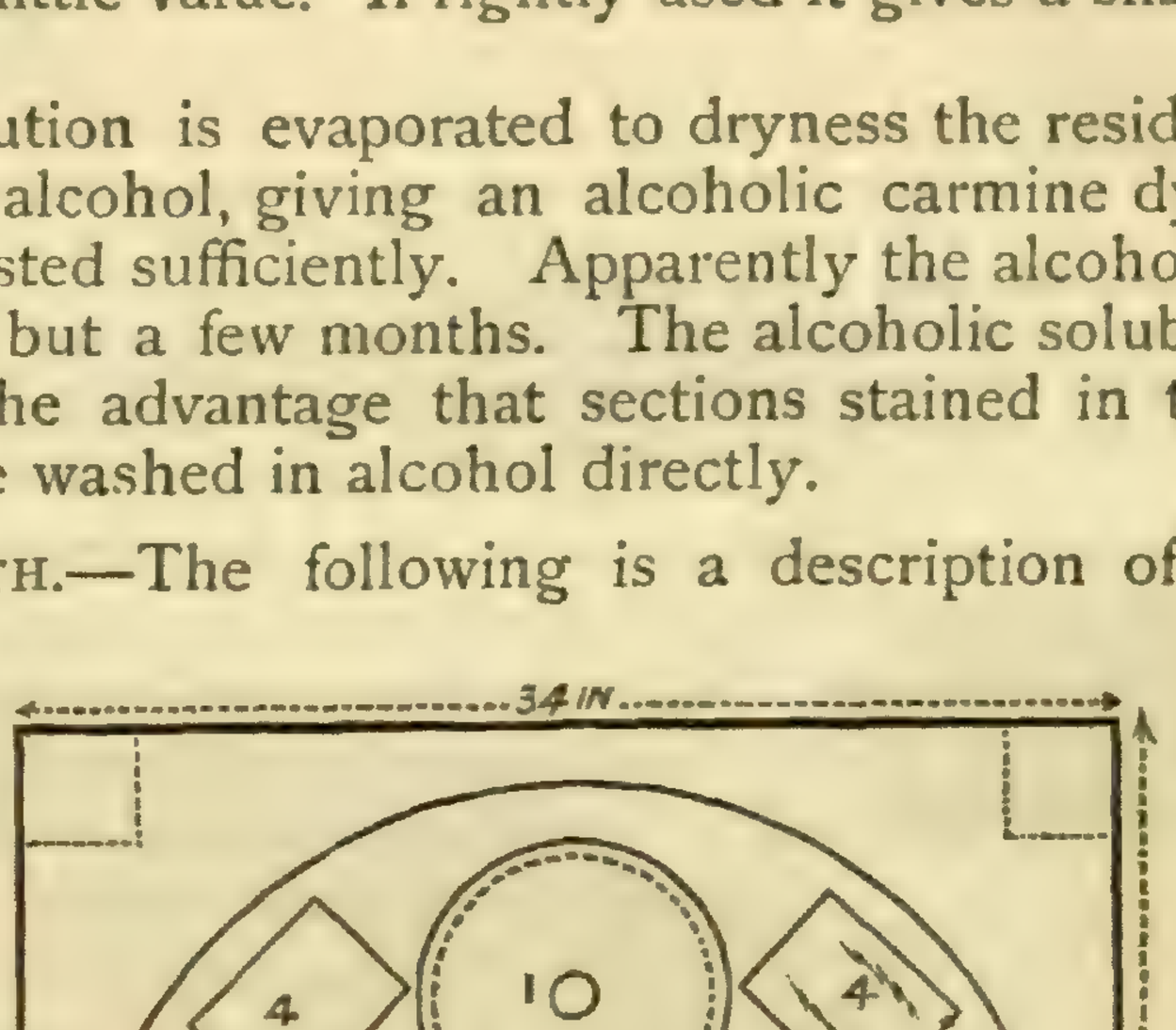

FIG. 1.—Surface view of the bath ni the table. 1, basin with lid on, 2, shelf with holes for dishes in basin; 3, open basins, 4, rectangular basins for slides; 5, tube for gas pipe; 6, hole for regulator; 7, hole for thermometer.

es between the nearest points of any two basins; and nearer the edge of the top, at the angles between the round basins, are four rectangular basins each five inches long, three and a half inches wide and two inches deep. In each of the large basins is placed, on movable supports, a shelf for the paraffine cups. This shelf is made from the circular piece of copper which was cut out of the top for the insertion of the basin. For each basin there is also a copper lid with a button handle in the center and a hole, a half inch in diameter, near this for a thermometer. When the bath is once regulated this thermometer can of course be dispensed with and the hole in the lid can be plugged up with a cork. By this arrangement the paraffine dishes are always kept dry and at a uniform temperature all over. The four rectangular basins are used for warming the slides. In each of them is a movable rack made of two tin slips, each about a half inch wide and folded as shown in Fig. 3. Each of these basins also has a copper lid with a button handle in the middle.

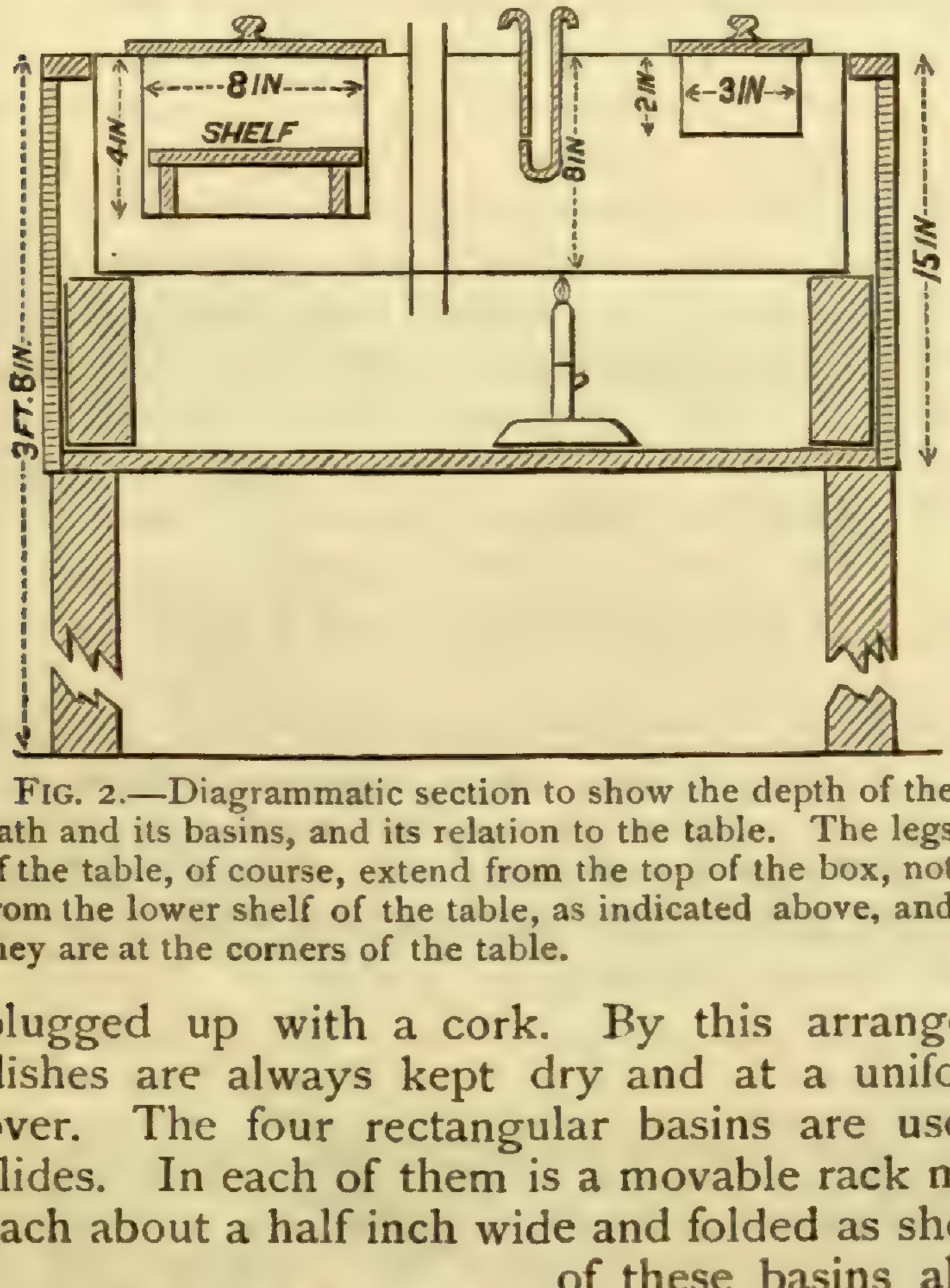

FIG. 2.—Diagrammatic section to show the depth of the bath and its basins, and its relation to the table. The legs of the table, of course, extend from the top of the box, not from the lower shelf of the table, as indicated above, and they are at the corners of the table.

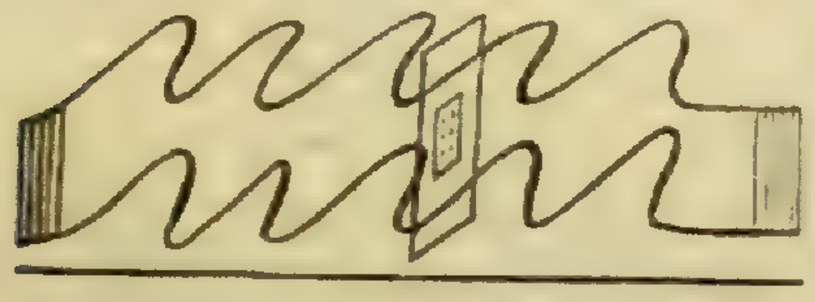

FIG. 3.—Supports for slides in rectangular basins.

Near the center of the bath a tube one inch in diameter passes from the top down to and through the bottom. This tube is the passage way for the glass tube that connects the burner under the bath with the gas jet above the center of the bath, and it should be soldered to the upper side as well as to the under side of the bottom of the bath. Near this tube are two others, each one inch in diameter, that project about one and a half inches above the upper surface of the bath, but are soldered with their lower ends flush with the under side of the top of the bath. One of these tubes is for the automatic regulator, and the other is for the thermometer. Through them the water is put in or taken out of the bath. The thermometer and regulator are each in a test tube with holes blown in the sides, about one and a half inches from the bottom, and with a good flange on the upper edge by

which it is supported on the copper tube. A bit of cotton in the bottom of the test tube protects the mercury bulb of the regulator or thermometer from any jars against the hard test tube. The holes in the sides of the test tube allow the water of the bath to come in direct contact with the mercury bulbs and at the same time they are up high enough to keep the mercury from running into the bath should either of the mercury bulbs break while in the tube. The copper bath is supported in a square box-table, the top of the bath being flush with that of the table.

This table essentially is a box on four legs, with a hole in the top slightly more than twenty-eight inches in diameter, and with a door at one end. The bath is supported on four props that rest on the lower shelf of the table, and around the inside of the table is a lining of common tin to protect against possible accident. By this means a steady flame is obtained and the loss of heat is reduced to a minimum. And by grouping the regulator, thermometor and gas pipe near the center of the bath, hindrances are practically done away with. There is also connected with the gas jet a small home-made glass Bunsen burner that is attached to the glass gas tube a little above the bath. It is very convenient for warming dip tubes, lifters, etc. In so large a bath as this two flames are required, but both are burned very low. The one burner is connected directly with the gas jet and the other by way of the regulator. After the bath has, so to speak, been once set it runs on uniformly and requires no attention. It is regulated by putting a thermometer through the hole in one of the lids into the dry chamber and shutting off the regulator burner when the chamber is warm enough. The temperature, as indicated by the thermometer that dips into the water, is always a few degrees higher than that of the dry chambers. When the thermometer in the water indicates a temperature of 60° C. the basins are warm enough to keep the hardest grade of paraffine melted. The whole stands at a convenient working height, about three feet eight inches, and is very satisfactory.—*Henry F. Nachtrieb, Fellow Johns Hopkins University.*

Suggestions as to the Preparation and Use of Series of Sections in Zootomical Instruction.—It is convenient to have in the laboratory prepared series of certain types, so that the student may supplement the information he has acquired from dissection by the study of these. Thus entire series of Limax and Cyclas and partial series of the earthworm and leech are almost indispensible for an accurate knowledge of the anatomy of these forms.

Slides 2′ × 3′ (*i. e.*, double the ordinary width instead of double the ordinary length) are most convenient for small stages, and fit into many forms of slide-cabinets. Mica covers may be cut for these, and have the advantage of cheapness.

Czokor's alum-cochineal (Arch. mik. Anat. xviii, 412) is an

exceedingly convenient stain for such purposes, as it penetrates an object of considerable size readily, and differentiates admirably. Thus a Limax may be left in the fluid twenty-four hours, afterward washed in water and the excess of coloring matter removed by seventy per cent alcohol before it is transferred to stronger alcohol. Sections of tissues stain in the fluid in from two to three minutes to two to three hours, according to the method of hardening that has been adopted.

The fluid is prepared as follows: Rub up seven grammes of cochineal with an equal quantity of burnt alum in a mortar, add 700 c.c. of water, and boil down to 400 c.c. Add a trace of carbolic acid, and filter.

Bismarck brown in concentrated solution in water or seventy per cent alcohol also stains well *in toto;* there is no danger of over-staining, as the excess of color is removed by alcohol. It is particularly to be recommended where cartilaginous parts are to be studied, or where the sections are to be photographed. [The use of plates in which the sensitized surface is impregnated with a weak solution of eosin (Jour. Roy. Mic. Soc., Dec., 1884, p. 969) is said to obviate the necessity of using special stains for photographic purposes.]

Schällibaum's collodion and clove-oil mixture (one volume of the former to three of the latter) is excellent for sticking the sections to the slide. Although it is possible by this method to stain the sections on the slide in either watery or alcoholic media, much time is saved, and on the whole more satisfactory results obtained by staining the objects previously *in toto*. The collodion medium stains slightly in aniline colors, if staining on the slide be resorted to.

The study of a slide containing a large number of sections may, in certain cases, be much facilitated by having a photograph of the slide enlarged two or three times by means of an ordinary view lens. Such an enlargement is frequently sufficient to indicate where an organ appears or disappears in a series, and thus to save time in the study of the individual sections.—*Professor R. Ramsay Wright, Toronto.*

A cheap Bell-glass for the Laboratory Table.—Taking a plain glass finger-bowl four or five inches wide and about two inches deep, a handle may be prepared by gluing a three-quarter inch cork to the bottom. Cut off the smaller end of the cork smoothly and cover it with marine glue. If the end of the cork is now heated over a spirit lamp until the glue takes fire, and the cork is quickly pressed with its glue-covered end upon the center of the bottom of the dish, you have a cork handle by which you can lift the dish.—*F. A. Ryder.*

A Simple Method of Injecting the Arteries and Veins in Small Animals.—The principle involved in this method is that

by the use of two injecting fluids, of different densities, one passing through the capillaries, the other arrested at the capillaries, the whole vascular system may be injected from the aortic arch.

The application of the principle is as follows: (1) The animal is immersed in tepid water and the heart is uncovered. (2) The apex of the single ventricle, in the case of an amphibian, or of the left ventricle in the case of higher animals is then laid widely open and the blood allowed to flow freely from the auriculo-ventricular aperture (see *p* in the figure). (3) A cannula is then inserted a short distance into the arterial bulb and the first ligature is fastened around the nozzle. The second ligature is then made ready around the base of the ventricle, thus surrounding the auriculo-ventricular apertures. (4) An ordinary gelatine injecting mass, stained deep red or purple, is in the meantime prepared.

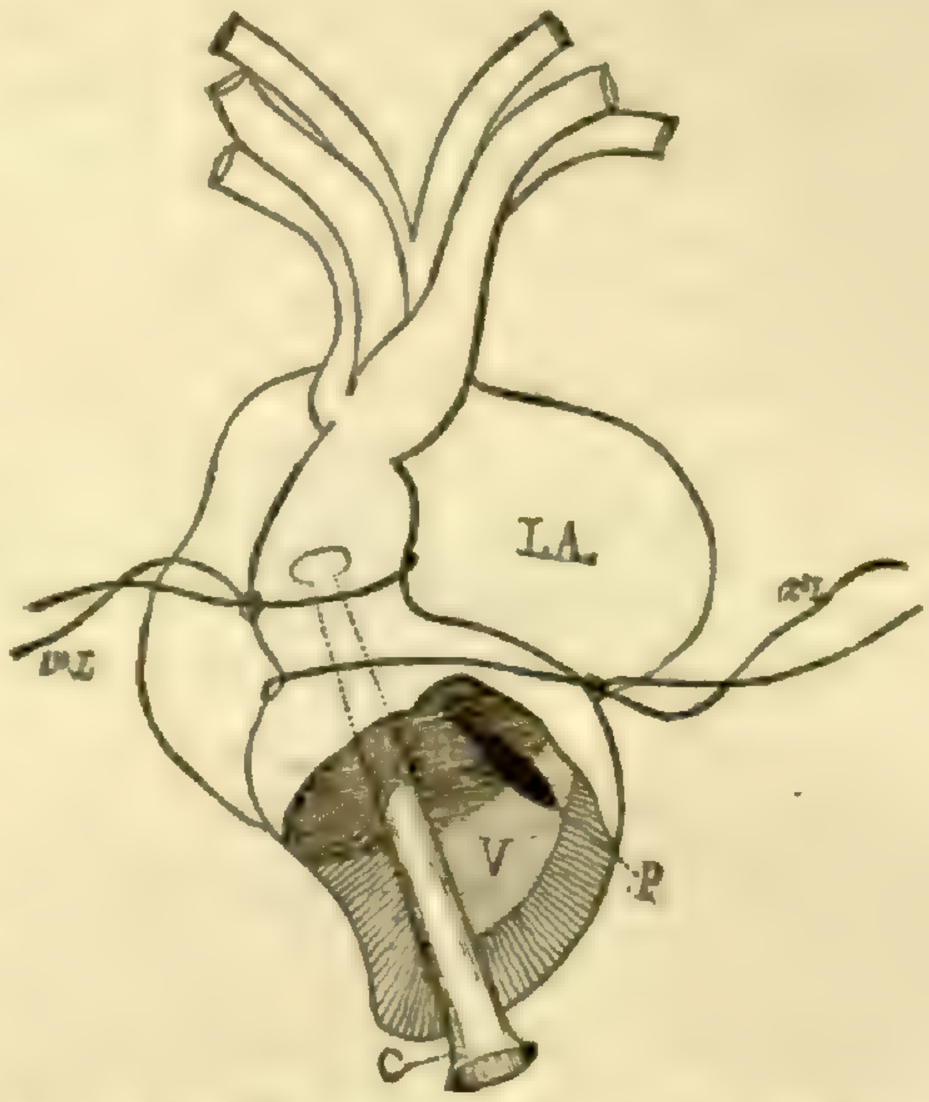

FIG. 1.—Illustrating method of preparing the frog's heart. *V*, ventricle; *LA*, left auricle; *p*, auriculo-ventricular opening; *1st L* and *2d L*, first and second ligatures; *C*, cannula.

When the body is thoroughly warmed, this mass is slowly injected. As the second ligature is still loose, a quantity of blood gradually followed by the gelatine issues from the auriculo-ventricular opening. (5) When the gelatine begins to run pretty clear, the second ligature is fastened and the syringe containing gelatine is replaced by another containing a red plaster-of-paris injecting mass. The latter drives the gelatine contained in the arteries before it as far as the capillaries, thus completely filling the venous system. When the gelatine is thoroughly cooled the animal is ready for dissection.

This method can be applied with considerable ease to all the smaller animals, such as frogs, lizards and pigeons, in preparation for class-work or investigation. Its advantages are numerous. Among its disadvantages may be mentioned the fact that alcohol cannot well be used as a preservative, because it dehydrates the gelatine, causing it to shrink and break up the veins. This difficulty is entirely obviated, however, by the use of Wickersheimer's fluid, in which the injection remains perfect for an indefinite time.—*Henry F. Osborn.*

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SCIENTIFIC NEWS.

—The Washburn Biological Survey of Kansas, says the Kansas City *Review*, has for its object "to investigate the fauna

and flora of a State which, together with Indian territory, holds the key to a more definite knowledge of the inter-relationship of four great faunal regions."

To the list of Kansas mammals as given by Professor M. V. B. Knox, some years ago, the survey has been able to add a number of species, among the most interesting of which, as considerably extending the known geographical distribution of the species, are the Mexican badger, two specimens of which have been found in Central Kansas, and the free-tailed bat, found in the north-eastern part of the State. Both are Southern species and their occurrence in Kansas is a matter of some surprise. It has also added to the State fauna the Georgian bat, and is able to record, through the favor of Professor Snow, the little shrew, *Blarina parvula*, from Western Kansas. It would call attention also to the long lost black-footed ferret, or prairie dog-hunter, of Western Kansas, whose rediscovery was recorded a few years since by Dr. Coues, and would urge our collectors and hunters to keep vigilant watch for it with a view to ascertaining its distribution and abundance in the State. Does the distribution of this ferret coincide with that of the prairie-dog? The survey is also gathering statistics with a view to determining the exact distribution of the prairie-dog in Kansas, and its relations to civilization and agriculture. Is the prairie-dog favorable or adversely affected by the advance of civilization upon him? Have the "deserted towns" of this animal become such owing to a desire to shun observation and molestation by man, or were the migrations which they record induced by desire for better forage grounds, or by other causes? Items of information tending to shed light upon the distribution, increase, or extermination, habits, and economic relations of this and other species of the animals of Kansas are greatly desired. For some of our species the historical material must be gathered at once, or it will never be fully known. With birds, as already intimated, the survey is not concerned.

In reptiles, perhaps the most interesting discovery is that of a second species of green snake, the slender green snake, *Cyclophis æstivus*, an austroriparian species, collected by Colonel N. S. Goss, at Neosho falls. Kansas is doubtless the northern limit of this bright-hued, active Southern serpent.

Of fishes the survey has made considerable collections, mainly of smaller forms. Three species new to science have already been described in its reports, and the pretty little zebra-fish of the Rio Grande river, known until recently by Girard's imperfect description only, has been re-discovered and fully described from material sent from Ellis, Kansas, by Dr. L. Watson. The zebra-fish has since proved to be one of the commonest fishes of Western Kansas, scores having been taken from a little stream near Garden City by the writer in two days' collecting last August. The lamprey eel of Kansas, parasitic on the buffalo-fish, etc., proves to

be usually the *chestnut* lamprey, and the material collected tends to confirm the suspicion expressed by Jordan and Gilbert in their "Synopsis of Fishes of North America" that this and the silvery lamprey may be only varieties of one and the same species.

—At a late meeting of the Royal Microscopical Society, Dr. Maddox read a paper, "An experiment on feeding some insects with a 'comma' bacillus, and also with another bacillus (*Bact. subtilis*)," illustrating the subject by preparations exhibited under the microscope.

Mr. Cheshire said that he must, in the first place, congratulate Dr. Maddox on the time he had been able to keep his bees alive in a state of isolation. They were not at all easy to keep so under ordinary circumstances. He had tried himself some similar experiments, and thought he had succeeded in infecting *Musca vomitoria;* but it might be well to remark that in one hive bee he had found eight or ten distinct kinds of bacilli, one of which had a distinct curvature. Amongst bee-keepers there used to be an idea that the bees had no diseases, although there was one affecting the larvæ, but directly a careful examination of the bees was made it was found that they were subject to a great many. One kind had the curious effect of causing all the hairs to fall out, and on examining bees which were so affected he found them all to contain large numbers of the short red bacillus. If any one intended to experiment in these matters it might be useful to know that if the bees were fed with food stained with aniline dyes very curious effects were produced upon the internal organs. Differentiation took place within the body, and when they came to dissect them afterwards they would find it a very great help.

—Among the new investigations started in the Department of Agriculture, not the least important is one relating to economic ornithology. This work has been begun as a branch of that of the Division of Entomology, of which Professor C. V. Riley has charge. Dr. C. Hart Merriam, a well-known ornithologist, and secretary of the American Ornithologists' Union, has been appointed a special agent to take charge of this part of the divisional work. Dr. Merriam will make his headquarters at Sing Sing, New York, until October 1st, and after that at Washington.

The scope of the investigation will cover the entire field of the inter-relation of birds and agriculture, particularly from the entomological standpoint. The inquiry will relate primarily to the *food-habits* of birds, but will include also the collection of data bearing on the migration and geographical distribution of North American species. In this last inquiry the department hopes to have the coöperation of the American Ornithologists' Union, Dr. Merriam being in charge of the Committee on Migration for said Union.

—An officer of the Italian navy (reports *Nature*) after a course of four months' instruction at the Zoölogical Station at Naples,

was attached to the corvette *Vettor Pisani.* After an absence of five months the first consignment arrived—the product of deep-sea work, of dredging and coast-fishery along the shores of Gibraltar, Brazil, and Montevideo; a second collection still more extensive than the first was made during a voyage from Monte-video to Cape Horn, and among the islands of the Patagonian group. Other collections have been made on the Peruvian coast, the Gallapagos islands, and from Panama; also animals from small pools and rivers in Peru. Those from Peru comprise two complete series of embryonic forms—one of a ray, the other of a toad. The *Vettor Pisani* continued its course from Peru to the Philippine islands and China. The results have been so satisfac-tory that three other Italian naval officers were received at the station, one of them being afterwards stationed at the mouth of the Red sea, while another is collecting in the Mediterranean.

—Dr. W. J. Lewis draws attention to the importance in legal cases (when it is often inpossible to determine whether certain blood stains are human or animal), of the evidence to be derived from a microscopic study of the hairs or textile fabrics of one sort or another generally found entangled with the blood-stains on a weapon that has been used in a murderous assault. He illustrates the value of such evidence by reference to actual cases, and points out the differences between human and animal hair, and the distinguishing features of hair from those of the more com-mon filaments which may be mistaken for it, such as the finer fibers of jute, linen, silk and cotton. The characteristic distinc-tions which exist between human and animal hair are briefly in-dicated under four heads viz: (1) The relative proportions of the cortical and medullary structures; (2) The size, shape and arrangement of the medullary cells; (3) The size, shape and arrangement of the superficial cortical cells; (4) The size and shape of the hair-shaft.—*Journal of the Royal Microscopical Society, June, 1885.*

—The effects of the poison of the cobra de capello have been studied, says *Nature*, by Herr Gnezda. The poison was obtained in India by causing the snakes to bite into snails or mussels wrapped in gutta-percha and filled with water. The watery solu-tion thus obtained was reduced by evaporation. The poison be-longs to the class of propeptons. Different vertebrates susceptible to the poison died when the dose of the poison amounted to three mg. per kilogramme animal. The time when death followed a full dose of the poison was very various. Rabbits died after half an hour, pickerels after an hour, frogs later, then cats, and lastly pigeons. Stronger doses hastened death. Dilutions and the introduction of artificial respiration delayed death. The poison affected the nerves, especially the central nervous system, and had hardly any effect on the heart.

— Prof. Robert von Schlagintweit, the eminent ethnographer and geographer, died June 13th, in Giessen, at the age of 52. The name of the deceased is chiefly connected with the journey of scientific investigation made by him in 1854–7, in Central India and the Himalayas, in conjunction with his brothers Hermann and Adolphus. The expedition was fitted out at the expense of the King of Prussia and the British East India Company, and added many important and interesting facts to our knowledge in the domains of geography, meteorology, geology, and ethnology. An account of the journey was published in English under the title of "Results of a Scientific Mission to India and High Asia." Prof. Robert von Schlagintweit also traveled in North America, and wrote several shorter works on his experiences there.

— Mr. Mellard Reade's presidential address to the Liverpool Geological Society has been reprinted in the form of a pamphlet entitled "Denudation of the two Americas." The essay may be regarded as a sequel to the address in which he discussed the effects of chemical denudation as a geological agent. He insists strongly on the importance of applying quantitative methods to the study of geological phenomena. In the present paper he calculates the amount of solid matter removed in river-water from the surface of some of the principal river-basins of America. Mr. Reade thinks that the matter which exists in chemical solution in river-water has more importance as a factor in the reconstruction of the earth than is generally recognized by geologists. —*English Mechanic.*

— Prof. C. V. Riley, entomologist of the United States Department of Agriculture, has published Bulletin No. 8, with 46 pages on the periodical or seventeen-year Cicada, comprising an account of *Cicada septendecim* and its *tredecim*, or thirteen-year race, with a chronology of all broods known. A circular has also been issued by the Division, containing lists of localities where these two races last appeared, and a request for information regarding the appearance of the insect during the past season. Brood XXII of Septendecim appeared in 1868, locally, in the following States: New York, Massachusetts, Vermont, Pennsylvania, Ohio, Indiana, Michigan, Delaware, Maryland, District of Columbia, Virginia, Kentucky, and Georgia.

— The second volume of the Proceedings of the Biological Society of Washington contains the following longer articles: The principles of zoögeography, by Theo. Gill; Certain phases in the geological history of the North American continent, biographically considered, by C. A. White; Notes on North American Psyllidæ, by C. V. Riley; remarks on the bag worm (*Thyridopteryx ephemeræformis*), by C. V. Riley, with ichthyological and ornithological articles by Messrs. Goode, Bean, Dresel, Stejneger and Ridgway; while Mr. W. H. Dall describes some Hydrocor-

allinæ from Alaska and California, and Mr. Lester F. Ward enumerates the plants added to the flora of Washington, from April 1, 1882, to April 1, 1884.

—It will be remembered that the Legislature of New York made an appropriation of $18,000 for a course of free public instruction at the museum in human and comparative anatomy, physiology and zoölogy, etc. The course having already proved successful, funds have been promised, as we understand, to enlarge the museum by the addition of the rotunda planned in the original designs for the entire building, by which a lecture hall capable of seating 1200 persons may be built, with other rooms for the display of collections. The museum authorities have greatly strengthened the scientific corps by the appointment of Mr. J. A. Allen, the eminent ornithologist, as an assistant in the museum.

—Volume VI of the Monographs of the United States Geological Survey is devoted to Professor W.M. Fontaine's contributions to the knowledge of the older Mesozoic flora of Virginia, bearing date of 1883, but only recently distributed. The work is based upon the results of several years' diligent search in the older Mesozoic strata of Virginia. It comprises 144 pages of description, and is illustrated with fifty-four plates, some of them reprints of Emmons' figures of Mesozoic plants from North Carolina.

—A new method of collecting rhizopods has been practiced by Professor H. Blanc, who obtained material from the deep water of Lake Geneva by lowering to the bottom a large St. Andrew's cross, to the four extremities of which are attached pieces of very thick glass. After three or four weeks this is raised to the surface again, and the fine mud that has collected on the pieces of glass removed with a brush.

—A new gutta-percha plant has been brought to the notice of the French Academy (*Nature*, May 21), by E. Heckel, who suggests that as a substitute for the *Isonandra gutta* Hooker, which is threatening to disappear, *Butyrospyrum parkii* Kotschy, be used, which possesses similar properties, and which is widely diffused throughout equatorial Africa, between Upper Senegal and the Nile basin.

—A new genus of fleas described by W. Schimkewitsch, under the name of *Vermipsylla alakurt*, has been found to infest cattle in Turkestan, producing great debilitation, or even death. It was observed in the greatest abundance during severe frosts. Originally it is nearly black, but when distended becomes white, with variegated bands (*Zoöl. Anzeiger*, VIII, p. 75).

—At the May 5th meeting of the London Zoölogical Society, Mr. J. Bland Sutton read a paper on hypertrophy and its value in evolution, in which he attempted to show that material changes

in structure might be the result of what was originally a pathological condition.

— At the same meeting Mr. E. T. Newton read a paper on the remains of a gigantic bird (*Gastornis plasseni*) from the English Lower Eocene. The author observed, reports *Nature*, that these fossils proved that in early Eocene times England was inhabited by a race of birds which equaled in their proportions some of the more massive forms of the New Zealand moas.

— Hon. J. D. Cox publishes in the Journal of the Royal Microscopical Society for June an interesting article on the structure of the diatom shell, in which he attempts to prove the actual presence of films of silex, whose tenuity is so great that they are not visible by ordinary transmitted light.

— The Des Moines Academy of Science has issued the first number of its Bulletin, which contains, besides an introductory note, an article by R. E. Call, entitled a geographic catalogue of the Unionidæ of the Mississippi valley.

— Professor J. H. Whiteside, the æronaut, has presented to Woodward's Gardens a canary twenty-two years old. The bird is sightless, songless and very feeble.

— We learn that Dr. Taschenberg, of Halle, is preparing a new edition of the well-known Bibliotheca Zoölogica of Agassiz and others.

— Dr. Franklin B. Hough died June 11th, 1885, aged 62. He was for a while United States Commissioner of Forestry, and gave much attention to that subject.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES.—April 14.—Dr. H. C. McCook stated that spiders allied to the line weaver, *Theridion tepedariarum*, preserve their activity and spinning habit while exposed to cold ranging from freezing point to zero; that after long and severe exposure they rapidly recover their activity when brought into a warm temperature, and at once resume their habits on the return of spring, even after a severe and prolonged winter. The young of the orb-weavers survive the winter in the admirably arranged cocoons provided by maternal instinct. Early in the spring many nearly full-grown spiders may also be found, all of which have safely weathered the cold months.

A paper entitled "Notes on Mesozoic cockroaches," by S. H. Scudder, was presented for publication.

April 28.—Mr. Morris stated his conviction that the swim-bladder in fishes was a degenerate organ, formerly of use, but now without an important function. The fact that in embryonic states

it is connected with the œsophagus by a duct points to the idea that it formerly performed, to some extent, the function of a lung. The speaker believed that in previous ages fishes visited the land in search of food much more frequently than now, and that an air-breathing apparatus was developed by a pouching of the œsophagus. When the increased number of predatory land animals compelled fishes to confine themselves to water, this structure degenerated.

A paper by Mr. W. S. Blatchley "On the genus Aphredoderus" was presented for publication.

Mr. T. Meehan, in the Botanical Section, remarked on the peculiarities of *Mammillaria haydeni*, and other allied species, the ovaria of which remain buried between the closely appressed walls of the mammæ from April or May until just before the next flowering season, when they stretch out to their full length in a single night. As in this species the fruit is two inches long, and bright red, the effect of its sudden appearance, which is certainly due to elastic projection and not to growth, is very striking.

May 5.—Mr. Willcox stated that Florida sea-urchins were covered in March with shells, some of which contained living mollusks. In January they were free from this covering. *Fulgur perversus* is embedded in the sand when spawning, and attaches the smaller end of the egg-string, first protruded, to a stone below her. When the entire string is liberated the portion last protruded floats out with the tide. As only four or five capsules are to be found in the mollusks at one time, the process of laying the string probably occupies weeks. The speaker stated that he had found specimens only three and a half inches long in the act of spawning.

Professor Heilprin exhibited a pebble from the yellow gravel near Glassboro', containing *Scolithus linearis.* This, which he believed to be the first instance of the occurrence of the fossil in New Jersey, pointed, as did other Silurian and Devonian fossils collected in the same locality, to the origin of the deposits in the eastern continental border.

Mr. A. F. Gentry presented "A Review of the genus Phrynosoma."

May 12.—Mr. Meehan presented the manuscript diary of Wm. Bartram from 1802 to 1822. The migration of birds, dates of blooming of spring flowers, etc., are carefully noted.

Professor Lewis exhibited specimens of fossil plants from the new tunnel at Phœnixville. Some minute phyllopods were also described. The same beds were found in abundance in certain beds at Gwynedd.

Professor Lewis also exhibited specimens of erythrite from Phœnixville, and of cuprite from Frankfort. The former has never before been found in North America, and the latter is new to the locality.

Professor Heilprin called attention to the grouping, by Professor Eugene Smith, of the phosphate beds discovered by the latter, with the Jackson and Vicksburg deposits, as Oligocene. The palæontological character of the beds was given, and the conclusion drawn that there was a strong line of demarkation between them.

"A review of the genera and species of Mullidæ," by E. A. Hall and T. Z. McCaughan, was presented for publication.

May 19.—Professor Lewis announced the discovery of genthite in the Lafayette soapstone quarry. It occurs in small, bright, emerald-green crusts, showing the stalactitic structure characteristic of the species. This discovery proves the presence of nickel in the Pennsylvania serpentines.

Mr. Jos. Willcox stated that genthite had also been found at Webster, N. C.

Dr. Leidy described a number of tape-worms of a new species from a trout. The specimens were mature, measured from three to eight inches in length, and contained eggs in the segments near the head. The name *Bothriocephalus cestus* was proposed for it.

Mr. Potts stated that he had found a digestive cavity in the hydroid without tentacles previously described by him, and had seen it capture and swallow its food. The name *Microhydra ryderi* was given to it; genus and species both new.

Miss Fielde stated that, as a high authority upon nerve tissue had suggested that its reproduction in the earth-worms she had experimented upon was simulated, and that such reproduction was impossible, she had carefully examined the specimens, and found the tissue to be real, and as sensitive as the primitive growth. All the life processes were now performed as completely by the worms which had been decapitated as by those which had not been injured.

May 26.—Professor H. C. Lewis gave the result of his studies of the extreme southern edge of the ice-sheet in Pennsylvania. Certain short ridges of stratified drift, which often seemed to represent a backward drainage of the melting edge of the glacier, were spoken of as marginal kames. The speaker then described kames, eskers or osars, as studied in various parts of the world, and discussed the various theories of their origin. The kames are of gravel, fine within, often coarse without, and boulders and till often lie upon them. They contain no shells, and their courses coincide with the general drainage of the country. These kames seemed to be due to sub-glacial streams draining the edge of the ice-sheet. When the terminal moraine rested against an upward slope this drainage was backward or into the ice.

June 2.—Mr. W. N. Lockington gave an account of the progress of European colonization in Africa, and the opposition to it likely to be presented by the spread of Islamism.

Mr. Potts called attention to a curious fresh-water sponge which

occurs in the dry bottom lands of the Colorado, hanging from branches of trees in districts which are flooded about six weeks in the year. The species had previously only been found in the rock cisterns of Bombay. It is *Mayenia plumosa* Carter.

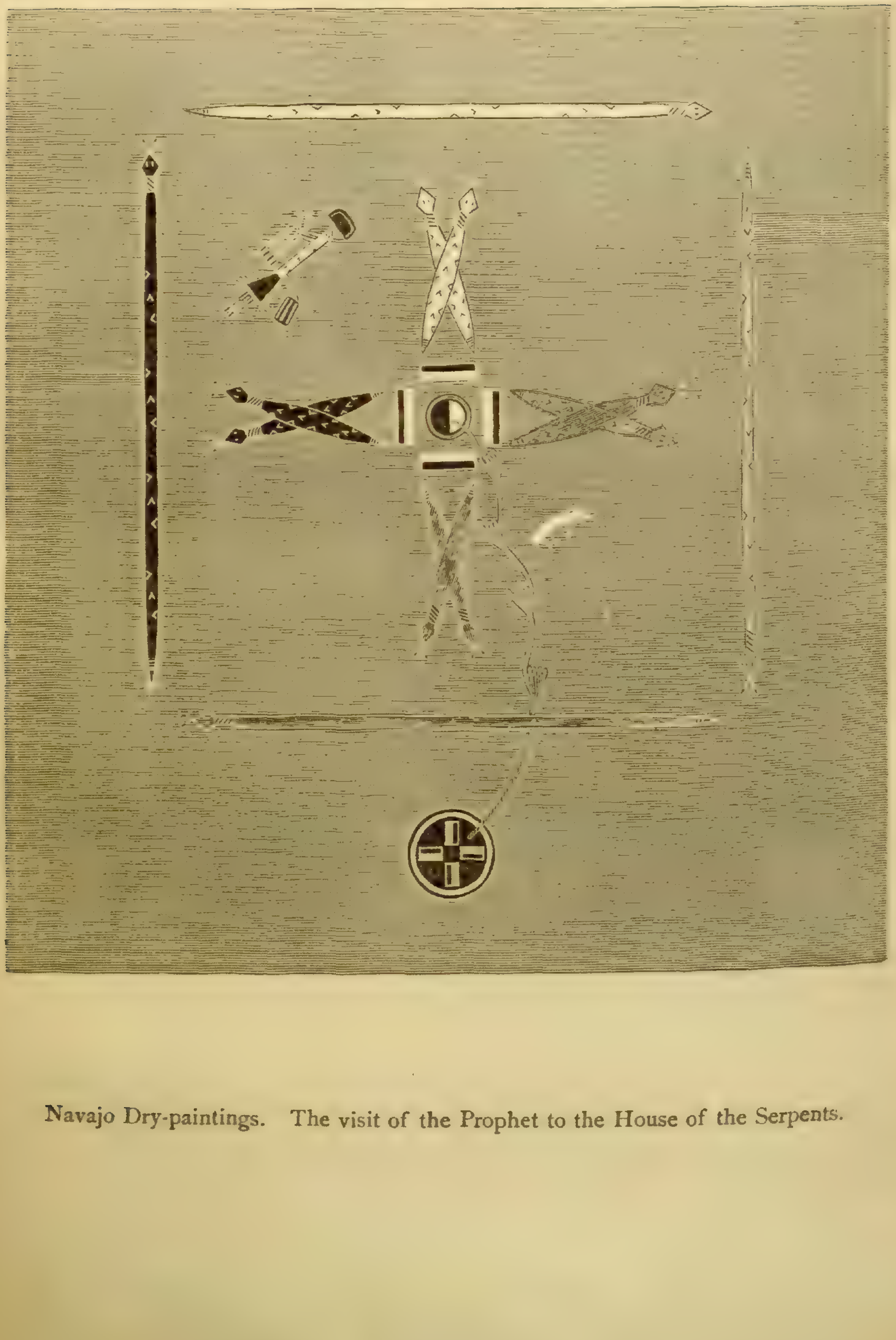
CINCINNATI SOCIETY OF NATURAL HISTORY.—July 7.—The following papers were read: "On a supposed fossil fungus from the coal measures," and "Obscure markings on rocks of Cincinnati group," by Professor Jos. F. James; "Notes on Tertiary of Alabama and Mississippi, with descriptions of new species," and "Notes on rare or little known Tertiary fossils," by T. H. Aldrich.

THE AMERICAN FISHERIES SOCIETY.—American Fish-Culture Association, order of exercises, Tuesday, May 5th, 1885: 1. Opening address, Hon. Theo. Lyman, president of the society; 2. Appointment of committees and other business. Recess. List of papers: 1. The giant clams of Puget sound, Professor R. E. C. Stearns; 2. Hibernation of the black bass, James A. Henshall, M.D.; 3. Smelt hatching, Fred. Mather; 4. The porpoise fishery of Cape Hatteras, Frederick W. True.

Wednesday, May 6.—5. Results of artificial propagation and planting of white fish in the great lakes, Frank N. Clark; 6. Does transplanting affect the food or game qualities of certain fishes? A. Nelson Cheney; 7. How to restore our trout streams, J. S. Van Cleef; 8. Exhibition of complete series of salmon and trout of North America, Tarleton H. Bean; 9. Objective points in fish culture, M. McDonald; 10. A glance at Billingsgate, W. V. Cox; 11. Work at Cold Spring harbor, Fred. Mather; 12. Oyster Beds of New York, Eugene G. Blackford; 13. On some of the protective contrivances developed by and in connection with the ova of various species of fishes, John A. Ryder; 14. The use of the throwing-stick by Eskimo in fishing, O. T. Mason; 15. The chief characteristics of North America fish fauna, Theodore Gill; 16. Suggestions as to the development of oyster culture in the Chesapeake area, M. McDonald; 17. Biennial spawning of salmon, Charles G. Atkins.

APPALACHIAN MOUNTAIN CLUB, April 8.—Mr. W. M. Davis presented a paper on geographic evolution, illustrated by models; Mr. Frederic Gardiner, Jr., gave an account of a horseback trip in Northern Arizona with lantern illustrations of scenery on the Navajo reservation and on Walnut cañon and the Grand cañon of the Colorado.

PLATE XXXII.



Navajo Dry-paintings. The visit of the Prophet to the House of the Serpents.

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MYTHIC DRY-PAINTINGS OF THE NAVAJOS.

BY DR. W. MATTHEWS.

I DESIRE, in this article, to call the attention of ethnographers to some pictures which are among the most transitory in the history of human art. They are the work of the Navajo Indians, a people who make no graven images of their gods, who do not decorate skins or robes, who place no symbóls on their rude and rarely-made pottery, and may be said to have no rock inscriptions. A few slightly scratched sketches on the cliffs of Arizona and New Mexico may, perhaps, be attributed to them; but the vast majority of carvings on stone in their country, and all of the most permanent character, are the work of the sedentary races. Seeing no evidence of a symbolic art among them, one might readily be led to suppose that they possessed none. Such was my opinion for two years after I had come to reside near them. Such is the opinion of many white men, who have lived for periods of from ten to twenty years among them.

During my residence of nearly four years in New Mexico I had heard of these drawings through the less conservative Indians and through a Mexican who had been many years captive among them. But it was not until last November, when I made a special journey to the Navajo country under the auspices of the Bureau of Ethnology, that I obtained unrestricted access to the medicine-lodge, saw the hieratic figures drawn, and was given permission to sketch them, much to the horror of the large majority of the assembled multitude.

The medicine-lodge, on the floor of which these pictures are made, is a simple conical structure of logs in the shape of an

Indian skin tent. It is about twenty-five feet in diameter at the base, internally, and about eight feet high under the apex. The only apertures are a smoke-hole above and a door, communicating through a short passage-way, in the east. The fire is built in the center of the floor except when the pictures are being made, then it is removed further to the east to make room for them. It is so dark in the lodge that on a brief winter day the artists must begin their work before sunrise if they would finish before night-fall and this it is essential they should do.

When the call is sounded in the morning, several young men go forth and bring in a quantity of dry sand in blankets; this is thrown on the floor and spread out over a surface twelve feet or more in diameter, to the depth of about three inches; it is leveled and made smooth by means of the broad oaken battens used in weaving.

The drawings are begun as much towards the center as the design will permit, due regard being paid to the precedence of the points of the compass; the figure in the east being begun first, that in the south, second, that in the west, third, that in the north, fourth. The figures in the periphery come after these. The reason for working from within outwards is a practical one; it is that the operators may not have to step over and thus risk the safety of their finished work.

While the work is in progress the chief shaman does little more than direct and criticise; a dozen or more young men perform the manual labor, each working on a different part. These assistants have had a certain ceremony of initiation performed over them before they are admitted to the lodge or allowed to help when these pictures are made; but they need not be skilled medicine-men or even aspirants to the craft of the shaman. They get nothing for their pains but their food, which, however, is abundant. Three times a day the person, for whose benefit the dance is performed, sends in enough mush, corn-cake, soup and roasted mutton to satisfy to the utmost the appetites of all in the lodge. The shaman, or *hathàli* (chanter or singer), as the Navajos call him, gets a rich present for his services.

The pictures are drawn according to an exact system, except in certain well-defined cases, where the limner is allowed to indulge his fancy. This is the case with the embroidered pouches the gods carry at the waist (see Plate XXXIII). Within reasonable

limits the artist may give his god as handsome a pouch as he wishes. On the other hand, some parts are measured by palms and spans, and not a line of the sacred design can be varied in them; straight and parallel lines are drawn on a tightened cord.

The pigments are five in number: they are black made of charcoal; white, of white sandstone; yellow, of yellow sandstone; red, of red sandstone, and "blue," of the black and white mixed in proper proportions; all ground into fine powder between two stones. The so-called blue is, of course, gray, but it is the only inexpensive representative of the cerulean tint they can obtain, and, combined with the other colors on the sandy floor, it looks like a real blue. These colored powders are kept on improvised trays of pine bark; to apply them, the artist grasps a little in his hand and allows it to flow out between the thumb and the opposed fingers. When he makes a mistake he does not brush away the color, he obliterates it by pouring sand on it and then draws the corrected design on the new surface.

The naked forms of the mythical figures are first drawn, and then the clothing is put on. Even in the representations of the *Bitses-ninez*, or long bodies, which are nine feet in length, the naked body of each is first made in its appropriate color—white for the east, blue for the south, yellow for the west, black for the north—and then the four shirts are painted on as shown in the picture (Plate XXXIII) from thigh to axilla.

It is the task of the shaman, when the work of painting is completed, to put the corn-pollen, emblem of fecundity, on the lips and breast of each divine form, and to set up the bounding plume-sticks around the picture. Then the one who gives the feast enters and is placed sitting on the form that belongs to the east—the white form—and looking eastward. Here the colored dust from various parts of the divine figures is taken and applied to corresponding parts of the patient, and many other ceremonies are performed, which it is not my purpose to relate here. When the patient has departed many of the spectators pick up the corn-pollen, now rendered doubly sacred, and put it in their medicine-bags. Some take dust from the figures on their moistened palms and apply it to their own bodies. If the devotee has disease in his legs, he takes powder from the legs of the figures; if in his head, he takes powder from the head, and so on.

By the time they are all done the picture is pretty badly

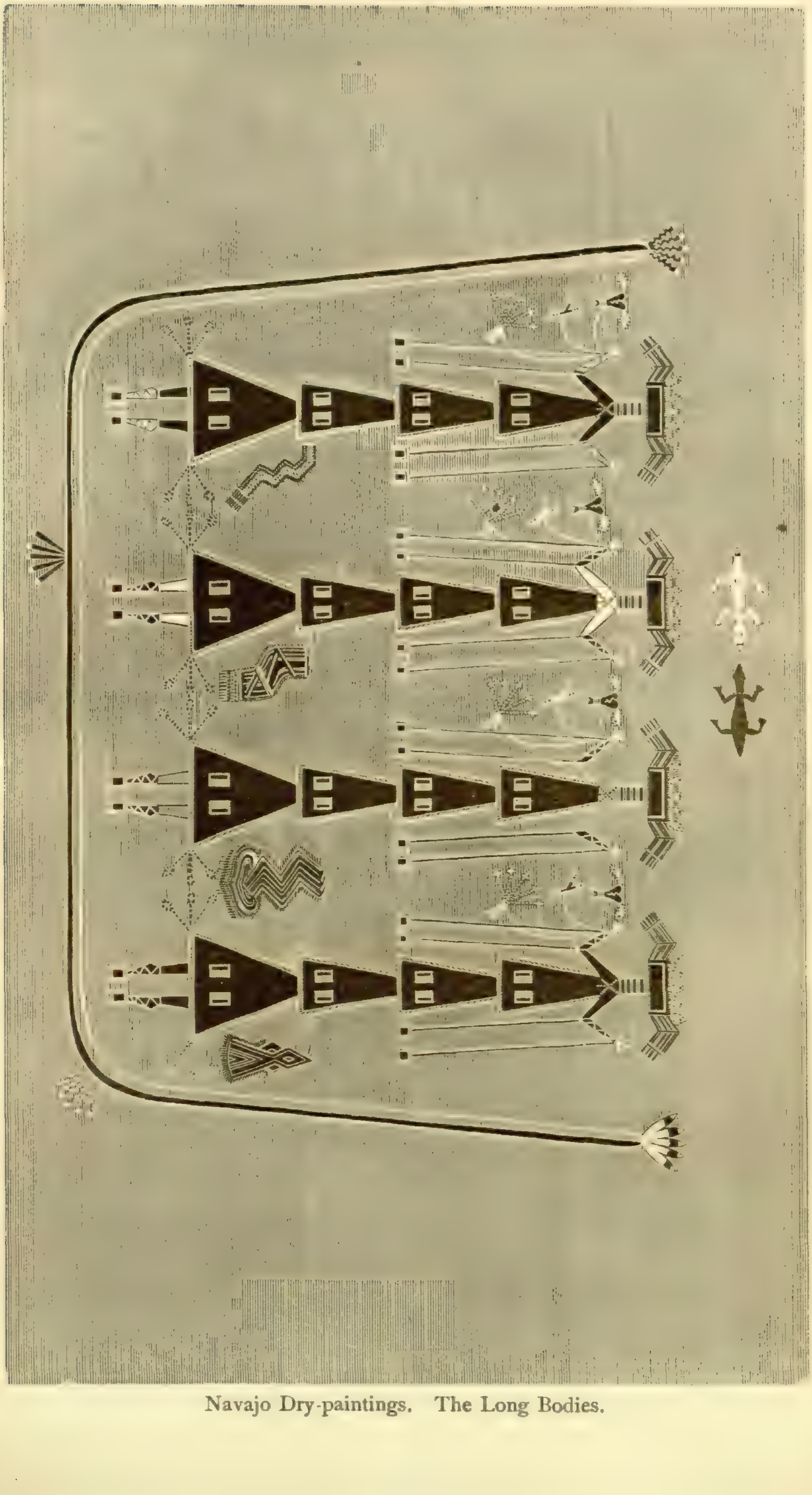
marred. Then it becomes the duty of the shaman to completely obliterate it; this he does with a slender wand, while he sings the song appropriate to this part of the ceremony. He begins with the figure belonging to the east, the white figure, and proceeds in the same order as was observed in making the picture, *i. e.*, in accordance with the apparent daily course of the sun. The figures at the margin are erased last, and when this is being done the bounding plume-sticks are knocked down. When no semblance of the picture is left the assistants gather the sand in their blankets, carry it to a little distance from the lodge and throw it away. Thus in half an hour after the completion of a large picture, ten or twelve feet in diameter, which has taken a dozen men, or more, eight or ten hours to construct, not a trace of it is left.

I have learned of seventeen great ceremonies of the Navajos, in which pictures of this character are drawn, and I have heard that there are, on an average, about four pictures to each dance. This would give us about sixty-eight such designs known to the medicine men of the tribe. But I learn that there are different schools or guilds among the medicine men who draw the pictures differently in some of the details, and that besides these seventeen great ceremonies there are many minor rites, with their appropriate pictures; so the number of designs in the possession of the tribe is probably much greater than that which I give.

The medicine-men aver that these pictures are transmitted from teacher to pupil, in each guild and for each ceremony, unaltered from year to year and from generation to generation. That such is strictly the case I cannot believe. No permanent design is preserved for reference, and there is no final authority in the tribe. The majority of the ceremonies can be performed only during the months when the snakes are dormant. The pictures are therefore carried over, from winter to winter, in the fallible memories of men. But I think it probable that innovations are unintentional, and that any changes which may occur are wrought slowly.

Out of this possible number of sixty-eight or more pictures I have seen seven, colored copies of which will, I hope, appear in some future report of the Bureau of Ethnology. The majority are too intricate to be reproduced in a satisfactory manner from a wood-cut on a page of this size, I therefore present illustrations of only two, and these of the simplest.

NORTH.



Navajo Dry-paintings. The Long Bodies.

The first four pictures in my collection are those of the *Dsilyidje hathal*, or chant among the mountains. This ceremony is also called *ilnasjingo hathal*, or chant in the dark circle of branches, from the great corral of piñon boughs in which it is performed. As the public ceremonies of the last night are varied and interesting, it is best known to the whites of all Navajo dances, and by our people is commonly called the hoshkawn dance, from the particular performance of the night, which seems most to strike the Caucasian fancy.

The whole ceremony is propitiatory to the *Yëïs*, or gods of the mountains; but when the Navajo prophet, who learned these mysteries, was brought around by a friendly god from place to place to be taught them, he was, on one occasion, brought into the house of the serpents. Now the worship of the snakes and water animals constitutes a separate dance, that of the *hojoni hathal*, or chant of terrestrial beauty, with its own pictures and ceremonies; but to indicate that the prophet visited the snakes in his wanderings and saw a portion of their mysteries, this picture, representing the home of the serpents, is drawn (Plate XXXII).

In the center of the picture is a circular concavity about six inches in diameter, intended to represent water. In all the other pictures where water was represented, a small bowl, I observed, was sunk in the ground and filled with water, which was afterwards sprinkled with powdered charcoal to give the appearance of a flat, dry surface. Closely surrounding the central depression are four parallelograms, each about four inches wide and ten inches long in the original pictures; the half nearer the center is red, the other half is blue; they are bordered with narrow lines of white. They appear in this and in some other pictures as something on which the gods seem to stand, and symbolize the *sha'bitlol*, or raft of sunbeams, the favorite vessels on which the divine ones navigate the upper deep. Red is the color proper to sunlight in their symbolism; but red and blue together represent sunbeams in the morning and evening skies when they show an alternation of red and blue. The sunbeam shafts, the halo and the rainbow are painted in the same colors, but they differ in form—the halo is a circle; the rainbow is curved and usually anthropomorphic, in Plate XXXIII, however, it is plumed. External to these sunbeam rafts, and represented as standing on them, are the figures of eight serpents—two in the east, white; two in the

south, blue; two in the west, yellow, and two in the north, black. They cross one another in pairs, forming four figures like the letter X. In each X the snake which appears to be beneath is made first, complete in every respect, and then the other snake is drawn over it in conformity with their realistic laws of art before referred to. The neck in all cases is blue, crossed with four bands of red, which, in the snake-like forms run diagonally, but in the man-like forms to be seen in other pictures, run transversely. The V-shaped marks on the backs of the snakes represent mottlings; the four marks at the end of each tail are for rattles. External to these eight snakes are four more of much greater length but colored to correspond with those already described. They seem to follow one another around the picture in the direction of the sun's apparent course, and form a frame or boundary. In the north-east is seen one of the *Yeïs*, who accompanied the Navajo prophet to the home of the snakes. In the extreme west is a black circular figure representing the mountain of *Dsilya-ithin*, whence they descended to visit the snakes. In the original picture the mountain was in relief—which I have not attempted to convey in my copy—a little mound of sand about ten or twelve inches high. From the summit of the mountain to the middle of the central waters is drawn a wide line in corn meal with four footprints depicted at intervals; this represents the track of the bear. Immediately south of the track is the figure of an animal drawn in the gray pigment, this is the grizzly himself, symbolizing the prophet.

During the journeys of the Navajo prophet before referred to, he came one night in the Carrizo mountains to the home of the four bear-gods (so runs the legend). They took from one corner of their cave a great sheet of cloud, unrolled it and exhibited to his view a picture. They told him that this picture must be drawn by the Navajos in their ceremonies; but as men had not the power of handling the clouds they should draw it on sand. This picture, a very elaborate one, not illustrated in this article, represents the *Yeïs* of the cultivated plants. It shows the central waters and the sunbeam rafts as in the first picture. It has four anthropomorphic figures extending from the center to different points of the compass, and highly conventionalized representations of the four principal domestic plants of the Indians—corn, bean, pumpkin and tobacco. The whole is surrounded on three

sides by the anthropomorphic rainbow. The body of the eastern god is white; that of the southern, blue; that of the western, yellow; that of the northern, black.

Here is an appropriate occasion to speak of Navajo symbolism in color. In all cases, as far as I could learn, the south is represented by blue, the west by yellow, the upper world by blue, the lower world by black and white in spots. Usually the east is represented by white and the north by black; but sometimes these colors are interchanged and the north becomes white while the east is black. The reasons for this change are too lengthy to be discussed here.

It is related in the myth which accounts for these mysteries, that this Navajo prophet, *Dzil'-yi-neyáni*, or Reared among the Mountains, was once led by the gods to a dwelling called the Lodge of Dew; it was built of dew-drops, and the door was made of many plants of different kinds. They entered and found four goddesses called *Bitses-ninez* or long bodies. The holy ones rose as the strangers entered, and they were very tall. The plumes on their heads almost touched the sky. They said to the prophet: "In the rites that you will teach your people when you return to them, you will invoke us by drawing our pictures. We stand here, one in the east, one in the south, one in the west and one in the north; but when you draw the picture you must place us all in the east."

The third picture in the series (Plate XXXIII) is supposed to be made in accordance with these instructions. To indicate their great height the figures are twice the length of any in the other pictures, except the rainbow figures, and each is clothed in four garments, one above another; for no one garment, they say, can be made long enough to cover such giant forms. The form immediately north of the center is done first, in white, and represents the east; that next to it, on the south, comes second in order, is painted in blue and represents the south. The form next below the latter is in yellow and depicts the goddess who stood in the west of the house of dew-drops. The figure in the extreme north is drawn last of all, in black, and belongs to the north. As before stated, these bodies are first made naked and afterwards clothed. The exposed chests, arms and thighs display the colors of which the entire bodies were originally composed. Some small animal called the *gloĭ* is sacred to these goddesses. Two of

these creatures are shown in the east, guarding the entrance to the lodge. The appendages at the sides of the heads of the goddesses represent the *glòï-bichá*, or head-dresses of *gloï* skins of different colors, which these mythic personages are said to wear. Each one bears, attached to the right hand, a rattle, a charm and a branch of choke-cherry in blossom (highly conventionalized). Some other adjuncts of the picture—the red robes embroidered with sunbeams, the forearms and legs clothed with clouds and lightning, the pendants from wrists and elbows, the blue and red armlets, bracelets and garters—are properties of nearly all the anthropomorphic gods shown in these pictures. The rainbow which encloses the group on three sides is not the anthropomorphic rainbow, it has no head, neck, arms or lower extremities. Five white eagle-plumes adorn its south-eastern end; five tail-plumes of some blue bird decorate the bend in the south-west; the tail of the red-shafted flicker is near the bend in the north-west, and the tail of the magpie terminates the north-eastern extremity. Throughout the myth not only is the house of dew spoken of as adorned with hangings and festoons of rainbows, but nearly all the holy dwellings are thus embellished.

The fourth picture represents the *Kátso-yisthan*, or great plumed arrows. These arrows are the especial great mystery, the potent healing charm of the dance. On the last night, many public *alilis* (shows, dances) may be given—shows of all sorts of societies and bands, shows adopted from alien tribes. From dark to dawn these continue around the great central fire and within the dark fence of evergreen branches. All of these may be changed, omitted, or have others substituted for them, except the dance of the great plumed arrow, this cannot be left out.

The three paintings remaining to be described are those of the *kledji-hathal* (chant of the night), or dance of the *Yeibichai* (grand-uncle of the gods). They represent some of the visions of another Navajo prophet named *Sho*. The myth recounting his adventures is interesting, but too long to be related here. In childhood and youth he showed signs of unusual wisdom. He often told his immediate relations that he held converse with the gods; but they doubted him until, as he grew older, he exhibited such unquestionable evidence of second-sight that the most skeptical were convinced. On one of his rambles he saw what he supposed to be a small herd of big-horn or Rocky-mountain

sheep, and went in pursuit. Four times he waylaid them and tried to shoot them, but each time when he drew his arrow to the head it would not leave the string. Then he knew the sheep to be divinities in disguise. He approached them; they threw off their sheep-skin coverings and revealed themselves as the *gáaskidi* or gods of plenty. They bore *Sho* to their home, admitted him to their sacred rites, taught him all their mysteries, and sent him back to his people that he might teach the mysteries to man. All his adventures and visions are embodied in the myths and rites of the *kledji-hathal.* When his mission was done he was taken back by the gods to dwell among them forever.

The form of the *gáaskidi* appears several times in the pictures. It is represented as having sheep's horns on the head, wearing a crown of black clouds garnished with lightning and fringed with sunbeams, bearing on the back a great sack made of the black thunder-cloud (said to be filled with all sorts of edible seeds and fruits), and leaning on a staff to indicate that the sack of plenty is a heavy burthen. Various other important characters of the Navajo mythology appear in these pictures.

One of the *Yeibichaí* paintings delineates a very singular vision or revelation of the prophet *Sho.* It is called the *tsiznaöle*, or whirling sticks. On one occasion *Sho* was led by the gods to the shores of a dark lake, on the borders of which grew four stalks of sacred corn, each of a different color. In the center of the lake lay two logs, crossing one another at right angles; near the two extremities of each sat a pair of *Yeis*, male and female, making eight in all. On the shore of the lake stood four more *Yeis*, three of whom had staves, by means of which they kept the logs whirling around with a constant motion, while the *Yeis* sitting on the logs sang songs which are still preserved in the multitudinous chants of this rite under the name of *tsiznaòle-bigin*, or songs of the whirling sticks. All the circumstances of this strange scene are duly symbolized in the painting.

The two other pictures represent scenes in the dance of the *Yeibichai*, as *Sho* witnessed it among the gods, and with some modifications they would make fair representations of the dance as it is enacted by the Navajos to-day. The pictures are beautiful, and appear of high interest when their symbolism is explained; but I have not space to describe them, and, as before stated, they are too intricate to be suitably illustrated here.

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 857, September number.)

V. The Conditions of Consciousness.

THE greatest mystery of the universe is the mystery of consciousness. That we can ever understand its innate nature is not to be expected. The mind may measure everything outside itself, but it cannot measure itself. The eye sees everything except the eye. There must always remain one thing unknown; that to and by which everything else is known. But though the nature of consciousness may be beyond our ken, its relations to matter and the mind are not necessarily so. Some of these relations are apparent. Others are within the reach of conjecture. We are therefore free to consider the mystery of consciousness from this point of view.

The character of consciousness has undoubtedly been greatly misapprehended, even by some very acute thinkers. It is customary to talk and write as if consciousness and mind were identical, or as if the words thought and consciousness were synonymous. It is, indeed, on this ground that the brain-mind theorists have based their deductions. They find that the existence of consciousness and the loss of brain force are closely related. Thought bears heavily upon the nerve cells. They sink beneath its pressure, lose their organization and yield energy, of which there is no evident physical display. This energy, as is claimed, is the element of consciousness, and its successive manifestations constitute the mind. But this amounts to a distinct claim that the consideration of the origin of consciousness involves that of the whole mental constitution, and that thought and the conscious perception of thought are one and the same thing; a hypothesis which may safely be disputed. For the mind impresses us with a sense of unity and continuity which certainly do not belong to consciousness. Its thoughts continue to exist, whether or not we are conscious of their existence. A thought may arise to our mental perception to-morrow, another next year, a third only after a decade of years. But they are evidently the same thoughts that we formerly knew. Their loss to sight has had no effect on their persistent existence. The action of consciousness or mental perception is, in fact, singularly like that of the eye. We per-

ceive to-day a landscape which we saw twenty years ago. There it has lain unchanged, all its salient points familiar to our sight, though we may have since wandered over half the world. So the eye of the mind wanders over a world of thoughts and suddenly perceives a mental landscape of which it lost sight twenty years before. There it lies, far more unchanged even than the physical landscape, for that has suffered innumerable changes, while the mental picture has seemingly remained utterly free from influences of change.

Whether consciousness is an energy in itself, or a forceless side product of energy is a question that has been considerably debated. Professor Huxley takes the latter view, and declares that consciousness is not an agent in determining action, but is a collateral result of the action. Professor Cope considers that "consciousness is not a necessary condition of energy," though "energy is a necessary condition of consciousness,"[1] and differs from Huxley in believing that consciousness exerts a directing influence over mental action. In respect to these views it is important to observe that the mental operations which are generally attended by consciousness are capable, in some cases, of proceeding unconsciously. There are on record many striking instances of the active operation of the mind during unconsciousness, or while consciousness was elsewhere directed, important results of reasoning being sometimes produced. There are few thinkers to whom minor instances of this kind have not occurred. Such cases would seem to prove that consciousness is not a necessary element of thought, and therefore not a determining agent in thought. On the other hand it must be remembered that such mental processes never begin in unconsciousness. In every recorded case they have been trains of thought with which consciousness was at first actively concerned, and whose movement has proceeded during a temporary lapse of consciousness, their final results again rising into the realm of conscious thought. Instances of this kind, however, are comparatively few, and seem only to occur where the preliminary train of thought has been intense, and the conscious attention close and active. This intense activity seems to set in movement energies of the mind, which, like a train of wheels set in motion by the hand, run on for some time after the acting agent has been withdrawn, and only slowly

[1] On Catagenesis, AMERICAN NATURALIST, Oct., 1884.

sink into a state of rest. There is not a shred of evidence that such mental movements ever take place without the preliminary attendance of consciousness. They may possibly be produced in a minor degree by less energetic consciousness, but in every case they soon sink to rest, as friction brings wheels to rest when their moving force is withdrawn. And the mind, no more than the wheels, seems capable of starting into activity without the aid of some directing agent.

There is nowhere in physical science evidence of the possible existence of a side product of energy which is not itself an energy. Motor energy varies in its mode of action, but every variant has a force influence of its own. A current of electricity, for instance, when resisted in its passage, here yields heat, there light and there magnetism, but the electricity loses in vigor with every such side expression, and the heat, light or magnetism at once exert force. The flash of light which gleams out when the electric current passes through the air, signifies a conversion of part of the current into the vibratory motion of light. May not the flash of consciousness which gleams out on the passage of motor energy from brain to mind signify a like partial side conversion of this energy? And if so it may possibly produce effects of its own, calling the mental organism into activity, or exerting some directing force upon the mental activities, as Professor Cope holds.

Under the hypothesis here advanced, that the brain is not the organ of the mind, but that there exists a distinct mental organism separate from though intimately related to the brain, the conditions of this organism must be closely analogous to those of all organized masses. We may, therefore, compare the mental organism with the crystal of some mineral. The latter is persistent, its internal relations of motion and attraction being in exact harmony. If undisturbed its internal conditions would remain unchanged indefinitely. But the motor energies of the external world penetrate the crystal and may disturb its organizing motions, producing changes in the relations of its particles. So a seed under conditions of isolation is a persistent organism, held intact by the harmony of its internal energies. Exposed to the inflow of external energy its organization changes. The instigating touch of such inflowing energy may set up long continuing changes in the motor relations of the particles of the seed,

and cause important modifications in its constitution. These cases seem closely analogous to what we know of the constitution of the mental organism, though the susceptibility of the latter to external influences is far greater. Yet it has a fixed organization through the harmony of its internal energies. It is exposed to the inflow of external energies through the medium of the brain. And its internal conditions change under the influence of these inflowing energies. But at every resting stage of its development it gains a stable condition of internal energies, which remains persistent during the temporary absence of consciousness. And consciousness appears to be a peculiar expression of the motor energy which flows from the brain into the mind. The nerve current appears to produce chemical disintegration in some highly unstable element of the brain cells, as in the muscle cells. The energy set free by this disintegration seems merely to intensify without changing the character of the influence producing it. It flows into the mental organism, and in so doing takes on the special condition of consciousness, or manifests consciousness as one of the effects of its intact with the mind. Its final effect, however, is to impress the mind with a new motor state, which directly or indirectly repeats the conditions of the instigating external energy.

If such be in any sense a correct conception of the character and relations of the mental organism, certain other necessary consequences follow. Not only does the mind receive energy from the brain, but its innate energies affect the brain, and set up disintegration in its cells like that produced by the nerve current. And the energy produced by this disintegration flows out as a nerve current over the motor nerves to the muscles, which it rouses into activity.[1] Such is the two-fold relation of the mind to external nature. But it has interrelations of its own. Thought energies flow from part to part of the mental organism, and ideas are evolved from their interconnection, much of the mental evo-

[1] The indications are that external energy does not flow directly into the mind, nor does mental energy flow outwards. In both cases an intermediate energy is used, that set free by chemical change in the tissues of the brain. The inflowing nerve current induces this change, and the mind is affected by the energy thus set free. In like manner the mind does not emit energy, or only to the slight extent necessary for inductive action. It exerts force on the brain cells, and induces a special emission of nerve energy. It constantly receives, but it never yields its stores of motor energy. It resembles a land-locked lake, into which hundreds of streams flow, but to which there is no outlet.

lution taking place through the interchange and combination of these internal energies. Yet the conditions of this activity seem identical with the other activities described. The mental organism has no more power of arbitrarily changing the relations of its own energies than has a crystal. All such changes arise through its connection with an external reservoir of energy, the brain. The seeming movements of thought through the mind are really actions of the energies of thought on the brain, the release of brain energy, and the inflow of this energy into another region of the mental organism. This mediation of the brain is signified by the physiological change that takes place, and also by the appearance of consciousness, a condition which seems only existent during motor interconnection of the brain and the mental organism.

We may reiterate here the fact that no organized mass—crystal, seed, solar system or mind—is capable of setting up new actions within itself, or arbitrarily instigating changes in its conditions of motor equilibrium. Such an action would be quite as impossible, if we may offer a homely illustration, as the old problem of a man lifting himself in a tub. Organizing motions cannot possibly change of themselves. Perturbations may arise through their interaction, as between the bodies of the solar system, but not permanent changes. And by the very conditions of their existence they resist change. All permanent change must come from the inflow and action of external energy, and it will be resisted to a degree in accordance with the rigidity of the organism. In the crystal, for instance, the resistance is vigorous. In the mind it is much less so, and varies extremely in minds of different degrees of development. If all mental change was produced by external impulse, then the brain might be its organ. But the existence of internal mental change renders this impossible. Such change can only take place under the instigation of external energy, and the brain is the source of this energy. The thoughts which seem to flow from region to region of the mind, evidently do so through the intermedium of the brain, since all activity of thought is attended with chemical change in the brain cells. And the energy thus yielded is the active agent in the new idea formed. It would seem as if every rapport between brain and mind instigated oxidation in the brain cells, the energy yielded flowing to the muscles, or to another region of the mind,

over the brain fibers, on the same principle as external energy penetrates to the mind over these fibers. In this view the mental organism has a space extension, equivalent to that of the cerebrum, and each region bears a relation like that of external nature to every other region.

The vividness of consciousness seems closely related to the degree of disturbance which it produces in the conditions of the mental organism. Energetic sensory impressions seldom fail to arouse consciousness, even if the mind is otherwise active. Less energetic ones may fail under such conditions. It is not unusual to discover that impressions have been unconsciously received during a period of mental abstraction. Possibly the movement of thought processes during unconsciousness is due to the small volume of energy engaged. An important fact, in this connection, is that unusual impressions arouse the consciousness more quickly and vividly than usual ones. The mind seems to become dulled to a sensation when it has become habituated to it. With every repetition of any special current of energy it seems to create less disturbance in the mind. This may be partly due, if the sensation is one to which immediate motor response is requisite, to the drafting off of part of the energy to the muscles. But even where this is not the case, and the impression is made wholly on the mind, its intensity diminishes with repetition, while all unusual sensations at once arouse active consciouness. Usual ones can only regain their original intensity of influence by an increase in their vigor. It would appear as if the vividness of consciousness depended upon the degree of change produced by a sensation in the mental conditions, and that each habitual sensation found accordant mental conditions, and therefore feebly affected the mind, while every new one produced a degree of change in accordance with its degree of rarity.

There is good reason to believe that every sensation that reaches the mind, however frequently repeated, is capable of awaking consciousness, and that only the completely reflex mental currents are absolutely unconscious. Thus certain tastes and sounds may be received with full consciousness an indefinite number of times. Yet with this rule the other holds good that an unfamiliar sensation most vividly arouses consciousness, and that all sensations less sharply affect the attention as they grow familiar. In all cases of the kind in which a sensation is seemingly

received unconsciously, this is due to the activity of the attention in some other direction. But if the attention is disengaged, every sensation may produce consciousness, no matter how familiar a visitant it may be to the mind.

The fact that when the mind is actively conscious in one direction it may be unconscious of the operation of important movements previously set up within its organism, or of the reception of new sensations, seems to indicate that the volume of consciousness which may exist at any one time is limited. It may sink below this volume, even to complete disappearance during inactivity of the brain, but it cannot rise above it. And the variations in the distribution of this volume of consciousness are of the utmost interest and importance. Now it seems to diffuse itself, and a broad field of the mind is perceived, the central ideas in the field of vision being clear, while others crowd more faintly in, like dimly-seem objects which crowd in at the sides of the eye. Now it becomes concentrated, and only a few, or perhaps only a single idea is very vividly perceived if the powers of inward vision are acting with energy. And while, as a rule, sensations arrest the attention much more vividly than thoughts, this does not always hold. In some cases of mental diversion the most vivid sensations pass unperceived.

This phenomenon of concentrated vision, as applied to the mind, has very important consequences. For the mind is utterly inactive except when energized by consciousness, and only that portion of it is active which is so energized. And as the activity of the mind governs the movements of the body, it follows that our voluntary actions, of whatever kind, are controlled, not by the mind as a whole, but by that portion of it which is active. This undeniable principle produces certain strange and important consequences. Ordinarily a certain number of our ideas are active, and particularly those deep-lying and firmly-based mental impressions and hereditary mental conditions which, acting together, constitute what we call judgment, or common sense. But there are several normal and some abnormal states in which this condition is changed.

One of these is in the case of strong emotion. As an earnest desire fixes the eye intently upon some single object, and causes eye and mind alike to ignore what lies beyond this object, while all the movements of the body are in response to the desire; so

an energetic emotion fixes the eye of the mind upon some single thought, while all the remaining conditions of the mind fade and vanish from sight. In such a case judgment or reason no longer governs our actions, for the group of mental conditions which constitutes these faculties is dormant. In deep grief the person affected yields utterly to his sorrow, and cannot be aroused from his depression. In intense fear no powers of reason remain to control the movements. In violent anger only the idea of revenge upon the object of that anger may remain. The furious man is, in a certain sense, irresponsible. His mind is an arrow moved by a single string. It discharges itself upon the obnoxious object, for there is no controlling force to restrain it. It is only when the paroxysm of emotion has passed away, and consciousness again spreads its revealing vision over the broad field of the mind, that other mental conditions spring into action, and deep remorse may follow an impulsive deed which was committed while all the springs of reason were dried up by the consuming heat of passion. As to the question whether a person is morally responsible for acts committed in such a state, it can only be answered, that every person is under moral obligation to bring his emotions under the control of his reason. The habit of unchecked indulgence in emotion or passion may lead to as serious consequences as the formation of any other bad habit.

A second normal mode of mental concentration, utterly differing from the above, is that known as reverie. In this the consciousness is not fixed upon one thought. It wanders freely from thought to thought, and its partial concentration is a result of inactivity instead of emotional energy. The mind is closed against impressions from without, and is also closed against the great mass of its internal stores, from the simple inactivity of consciousness. The circulation becomes sluggish. The waste of brain tissue is decreased. Only a slight degree of nerve energy flows into the mind, and only a few of its countless store of ideas are aroused to activity. And the consciousness is not concentrated upon these. It flows freely over the links of association.

The dreaming state is merely an intensification of this state of revery. Now the circulation is reduced to its lowest point. Exterior impressions, except they be very violent or very unusual, fail to affect the mind. The inner store of ideas is alike inactive. In its extreme state this produces dreamless sleep. But in a less

extreme case the mind is partially active. Some oxygen visits the brain. The wasted nerve tissue is being reproduced. Conditions arise in which oxygenation feebly takes place, and the free energy of the nerve cell is given off. These conditions may arise under the influence of some impressions upon the nerves of sense, or under that of some intimate connection between a locality of the mind and a reorganized region of the brain. In either case a slight degree of energy flows into the mind, so slight that only a very limited field of thought becomes active. The results are very striking. These few active thoughts form our whole mental world. There is no force of exterior sensation or of interior judgment to control them. The most absurd conceptions seem to us to be actual facts. Its most vivid perceptions are in every case facts to the mind. Ordinarily these are sensations of outward objects. But where sensation is at rest the dominant idea assumes the appearance of an external reality. And where judgment is at rest the incongruity of an idea with actual facts may remain unperceived, though even in dreams absurdity becomes apparent, as though the judgment were partly aroused.

There are other characteristics of the mental organism which aid in assimilating it to physical organisms. It impresses us as if subject to variations of temperature. Its emotional states lead to the conception of hot or cold states, and the effects which they produce are very interesting. Thus fear or terror impresses us as a chill of the mental organism. And its effects are singularly like those of cold on the body. The latter when chilled becomes sluggish, dull, torpid, strongly predisposed to sleep. Intense fear in animals yields similar effects. They grow paralyzed, as it were, torpid or inactive in condition, and probably with dulled sensibility to pain and a general inactivity of consciousness. The condition of the seemingly charmed bird is probably of this character.[1] On the other hand passion is a state of heat. Its effect is to instigate excessive activity, violent movements, vivid consciousness.

[1] "Fear, alarm, terror, horror, in their major degrees at least, frequently paralyze all power of self-preservative action, creating a dangerous immobility of body, with an accompanying fixity of stare. This condition is often described as a kind of fascination, of which the main features are powerlessness of mind and body, with the gaze helplessly fixed on some dreaded object, generally some powerful enemy, such as a serpent. * * * In a minor degree fear may beget stupidity or mental confusion, leading to injudicious or useless action." Lindsay's Mind in the Lower Animals, II, 235.

Between the extreme states we have the condition of pleasure, in which the mind seems gently warmed, and of gloom or depression, in which it seems similarly chilled.[1] The reasoning power is most efficient in calm states, when the temperature is normal. Then consciousness is diffused and its vision extended. In the other conditions it becomes more concentrated, until, in extreme heat or chill, a single idea or feeling dominates the mind.

We have not space here to consider the more aberrant conditions of mentality, such as somnambulism, hypnotism, insanity, &c., and the various strange phenomena which attend injury to the brain. None of them are incongruous with the idea that the mind is a distinct organism, and the brain its instrument of activity. Nor can we consider the many interesting relations of thought to thought or memory to memory, and the interaction of memories which lie at the basis of the evolution of ideas. Many of these are highly interesting and peculiar, yet there is nothing in them inconsistent with the hypothesis we have advanced. It will suffice to say that no thought ever calls up another unless they are directly or indirectly related, or associated in time or place of reception. It may be said, however, that our ideas differ widely in their degree of fixity in the mind and influence over its movements. Below all, as the basis of the organism, lie a series of deeply-based hereditary conditions, gained during ages of mental development. These are very persistent, and strongly resist warping influences. And the effort to perform any action inconsistent with them is vigorously resisted, even though we may be very faintly conscious of the source of the resistance. The mental development obtained during youth is also deeply based, and actively resists the warping influence of later impressions. The later the impression in date of reception the less firmly does it seem implanted, as if these late impressions were but slight and superficial affections of the more deep-laid early stages of development.

[1] "In certain animals there is occasionally a perfect 'wildness of joy,' great intensity of mental excitement from pleasurable emotions. Thus Darwin speaks of the 'madness of delight' in a stickleback, meaning, no doubt, exhuberance of joy, or uncontrollable animal spirits." Ibid, II, 233.

Thus strong pleasure seems to produce general activity of mind and body, while deep grief or depression from any cause produces sluggishness and inactivity of consciousness, just the effects which would naturally flow from states of heat or chill in a physical organism.

In this connection a consideration of great importance and interest arises. It is certainly a singular fact that in the very exact transmission to the germ of minute features in the physical organization of the parent, the mental organization is never transmitted except in its basic characteristics. Every organ of the body is reproduced, with all its powers inherent. The cerebrum is reproduced and develops in company with the other organs. The fact that these organs are functionally copies of those of the parent proves that the reproduction is not only of material form but of the parental motor conditions. This equally applies to the cerebrum, whose motor conditions should fully reappear in its development. Yet if these motor conditions are the powers of the mind they certainly do not reappear. In every individual a new mind has to be built up. The body, cerebrum and all, may attain its full development and the mind remain in its germinal state. Evidently it is a constituent of the individual alone, and not a something that may be hereditarily transmitted. The character of the cerebrum limits and controls the extent and direction of the mental development, and imposes certain hereditary characteristics on its primary phases of unfoldment, but not a trace of the special mentality of the parents reappears in the child. This indicates that the mind is the property of the individual alone, in whose life it is developed, and whom it may survive. The whole physical frame, including the cerebrum, is represented in the germ, but the mental organism is never transmitted. This is certainly a fact of high significance.

The condition of emotion is one that seems analogous to conditions existing in every organism. It appears to be a state of heat or cold, strong passion, for instance, being an intensely heated state, and deep fear a state of shuddering chill. The mind has also its attractions and repulsions, and these seem to be closely concerned with its activities. Very many of our movements are directly due to drawings in some direction or towards some object, or repulsions from some object. The motives which govern our movements are very frequently motives of attraction or distaste, and with these motives some degree of the emotional state usually exists, a slight warmth in the case of attraction and a chill in the case of repulsion. Possibly some condition of these agencies is concerned in the changing relations of the mind to the brain, and may be the motor influence by which contact is effected,

energy set free and consciousness called into existence. In this connection attention may be called to Mr. J. S. Lambard's experiments on heat conditions during mental action. He found that emotion had far more influence than thought in this direction. A few minutes self-recitation of emotional poetry yielded more heat than several hours of deep thought. In the latter case the energy set free seems to have been employed in mind development. If the poetry was spoken less heat appeared. Here energy was used in muscle movement.

The considerations here taken in regard to the conditions of consciousness, and the relations of energy to the mental organism, seem to lead to the conclusion that every organized mass, when its internal relations become disturbed by the inflow of discordant external energies, must feel some influence more or less closely allied to consciousness. But if the vividness of consciousness in any sense depends upon the mobility of the organism, and the extent of the disturbance produced in its internal conditions, then it may pass through many degrees of unfoldment, from an excessively vague and generalized effect to the sharply specialized condition of human consciousness. In every case there is resistance to change. But in a rigid crystal the resistance is very great, while in a mobile mind it may be excessively slight, and disturbance of conditions be produced by influences of the utmost delicacy. It must be borne in mind, however, that in man consciousness accompanies action of energy on the mental organism only. Action upon the muscles, though yielding equal disturbance, is never attended by consciousness. Thus the peculiar conditions of substance which occur in the mental organism may be absolute requisites to this effect. It is also requisite to consciousness that the inflowing energies shall act only to modify the motor conditions of organization, not to produce disintegration, or to disseminate themselves as generalized motions.

With the lowest animals consciousness must be exceedingly vague and inactive. Their sensitiveness is undeveloped, their sense organs in embryo, the conditions to which they are exposed nearly unvarying. Most of their actions must be reflex. Yet some feeling of every new mode of impression must be experienced, and this feeling attends and perhaps aids in every step of upward evolution. The frequency and activity of consciousness

increases as we ascend in the animal scale. And what was once conscious condition falls steadily back into the realm of the unconscious, as higher stages of this activity arise. Yet even in lower man consciousness is dull in action and limited in range as compared with civilized man. Customary actions and thoughts tend to lose all sharpness of conscious definition, and the customary rules far more supremely in lower men and in the brute realm than in the world of civilization.

By this dulling of customary sensations consciousness is constantly set free for superior labors. It is actively exerted in getting a firm grasp on every new condition presented to it. But this once gained, attention is set free and reaches outward and upward. The new acquisition sinks deep into the mind, to be recalled at intervals, and perhaps in time to become a constituent part of the mental constitution. In the case of the child learning to walk, for instance, consciousness is vividly concentrated upon its efforts. But the movement once gained the attention is set free for devotion to other things, and the motion of walking may finally be performed unconsciously. Numerous other instances of this kind might be adduced, leading up to that often quoted and extraordinary one of the nearly or quite unconscious action of the fingers of the pianist.

In regard to mental labors the same rule applies. We are constantly exercised in observing new facts, imagining new conditions, forming new ideas. Each addition to our mental stores occupies the consciousness more or less exclusively until it becomes an habitual occupant of the mind, after which the attention is released for devotion to new labors, and the idea thus gained sinks back into the fabric of the mind. It may be recalled at will, but it no longer has a despotic control of the consciousness. In this upward progress of the mind we are often inclined to believe that the superiority of higher man is intellectual only, and that in regard to acuteness of the senses he has fallen behind the savage. Yet this is not the case. He may have lost acuteness in respect to distant vision, or sharpness of hearing, but his sensitiveness has grown far more diversified. He can see countless delicate shades of color and variations of form, can appreciate the most minute variations of musical tone, can distinguish delicate changes of odor and taste of which the savage is utterly incapable. His senses have thus become excessively more delicate and

varied in their powers, and his mind responsive to a greater variety of impressions.

It is in his ideas, however, that civilized man so greatly overtops the lower world of life. His mind has been for ages pushing deeper and deeper into the realm of the unknown like an eating sea that is cutting its way steadily into the land. Before it lies the unknown, stretching away into the infinite. Behind it lies the known, half or wholly buried beneath the shrouding waters of the sea. The surf line is the line of consciousness, the border between the known and the unknown. Here consciousness mines forever into the coast line of facts, letting every new-gained fact float out to come to rest on the quiet sea bottom, the stores of recent memory lying half visible in the shallow waters, while in the deep sea beyond lie the layers of ancient acquirement which have become to us hereditary capabilities, the native stuff of the mind. What new and deeper powers the senses may yet attain, what new susceptibility the mind, cannot be said. We see rising dimly and shapelessly around us new phenomena, new stuff for thought on which the mind of future man must work, and every new age may safely say to the ages of the past: "There are more things in heaven and earth, Horatio, than are dreamed of in your philosophy."

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A BRIEF BIOGRAPHY OF THE HALIBUT.

BY G. BROWN GOODE.

THE halibut, *Hippoglossus vulgaris*, is widely distributed through the North Atlantic and North Pacific, near the shores, in shallow water, as well as upon the off-shore banks and the edges of the continental slope down to the depth of at least 400 fathoms. The species has not been observed in the Western Atlantic south of the fortieth parallel; stragglers have occasionally been taken off Sandy Hook, Block island and Montauk point. It ranges north at least to Cumberland gulf, latitude 64°, to Holsteinborg bank in Davis' strait, and as far as Disko and Omenak fiord, latitude 71°, on the coast of Greenland, five or six degrees within the Arctic circle. It occurs along the entire west coast of Greenland, and is abundant about Iceland and at Spitzbergen, in latitude 80°. No one knows to what extent it ranges along the European and Asiatic shores

of the Arctic ocean, but it has been observed on both sides of the North cape, in East and West Denmark, and from the North cape, latitude 71°, south along the entire western line of the Scandinavian peninsula, in the Skager Rack and Cattegat, though not, so far as I can learn, in the Baltic sea. The halibut is occasionally seen in the southern part of the North sea and in the English channel, but never, in the Eastern Atlantic, south of latitude 50°. There is yet some question whether it is found in the south of Ireland, though some of the largest individuals recorded from Great Britain have been taken in the Irish sea, off the Isle of Man.

On the Pacific coast the halibut, which has been shown by Dr. Bean to be identical with that of the Atlantic, ranges from the Farallones islands northward to Bering straits, becoming more abundant northward. "Its center of abundance," says Bean, "is in the Gulf of Alaska, particularly about Kodiak, the Alexander archipelago and the Shumagins. Large halibut are numerous about the Seal islands, but the small ones have been killed by the seals. I have heard from good authority of their capture as far north as Saint Lawrence bay, near East cape, in Siberia. It has several times been reported from off the heads of Marcus bay, Siberia." It is occasionally taken off San Francisco and about Humboldt bay. In the Straits of Fuca and in the deeper channels about Puget sound it is taken in considerable numbers. A large halibut bank exists in the mouth of the Straits of Fuca, about nine miles from Cape Flattery in a north-westerly direction, and the capture of this fish is an important industry to the coast Indians.

The halibut is emphatically a cold-water species. That it should range nine or ten degrees farther south on the American than on the European coast, is quite in accordance with the general law of the distribution of fish-life in the Atlantic; indeed, it is only in winter that halibut are known to approach the shore to the south of Cape Cod, and it is safe to say that the temperature of the water in which they are at present most frequently taken is never, or rarely, higher than 45°, seldom above 35° and most often in the neighborhood of 32°. Its geographic range corresponds closely to that of the codfish, with which it is almost invariably associated, the cod is, however, less dependent upon the presence of very cold water, and in the Western Atlantic is found

four or five degrees—in the Eastern Atlantic at least two—nearer the equator, while the range of the two species to the north is probably, though not certainly, known to be limited relatively in about the same degree. In the same manner the halibut appears to extend its wanderings further out to sea, and to deeper and colder waters than the cod. Although observations on this point have necessarily been imperfect, it seems to be the fact that cod are very rarely found upon the edge of the continental slope of North America beyond the 250-fathom line, while halibut are present in abundance upon the outer slope.

The name of this fish is very uniform in the regions where it is known, though, of course, subject to certain variations in the languages of the different countries, for its characteristic features are so unmistakable that it is rarely confounded with other species. The only fish for which it is mistaken seems to be the turbot of the European coast, with which it sometimes interchanges names. It is said that in Scotland the halibut is frequently called the turbot, and Yarrell has expressed the opinion that in instances where it has been claimed that halibut had been taken in the south of Ireland the turbot was the species actually referred to.

"Halibut" and "holibut" are words which are as old as the English language. In Germany the fish is called "heilbutt" or "heiligebutt;" in Sweden, "hällefisk" or "hälleflundra," while in Holland it is known as the "heilbot."

In studying these names it should be borne in mind that "but" or "bott" is only another word for flounder or flat fish, and that the English, Dutch, German and Scandinavian prefixes to this word or the equivalent word flounder are presumably of the same meaning. A false derivation has been imagined for the name, which is exemplified in the German word "heiligebutt" just mentioned, and also in an English spelling, which is sometimes encountered, "holybut." This idea is without foundation, for the halibut has never been reverenced more highly than any other species of flat fish, and the derivation is as fanciful as "haul-a-boat," which our New England fishermen have frequently assured me was the proper name, having reference to the size and strength of the fish. The true derivation of the word may best be understood through a study of its Scandinavian names, from which it appears that the prefix has reference to the holes or deep

places at sea in which the fish is found, and that the name simply means "a deep-sea fish," or "a deep-sea flounder."

The general distribution of the halibut having been sketched in outline, it may, perhaps, be appropriate to discuss more fully the range and abundance of the fish upon the coast of North America, and to describe the regions where it is sought by American fishing vessels.

Halibut are taken very abundantly on Holsteinborg bank, at the southern entrance to Davis' strait, latitude 67° north and longitude 54° to 56° west, where several Gloucester schooners have in past years obtained large cargoes of salted fish. In Etzel's "Grönland," it is stated that halibut are taken chiefly in the southern part of North Greenland, and everywhere on the shoals among the islands in the district of Egedesminde, especially about Agto, Riskol and Ikerasak, in latitude 68°, and somewhat less near Disko, in latitude 76°. They are captured most abundantly in the spring and fall. They are even taken, at greater depths, as far north as Omenak, in latitude 71°. In a later work Rink asserts that "the Netarnak or larger halibut is found on the banks, as well as in different places outside the islands, up to 70° north latitude, in depths of from thirty to fifty fathoms." In the same later work Rink remarks that halibut are plentiful in the fall about Egedesminde, and especially about Agto, the southernmost outpost of North Greenland. Etzel goes on to state, regarding the occurrence of halibut in South Greenland, that in July and August they are taken on the outer coast and among the islands at depths of thirty to fifty fathoms, while in winter they frequent deeper regions and are but seldom seen. Rink narrates that in 1809 there were taken among the islands off Godthaab (64° 8′ north latitude) 2000 halibut, and that in a single half-day two boats took over one hundred. They are rarely taken in the district of Julianshaab, in latitude 60° 43′ north.

Peter C. Sutherland, writing of Riskol bank, in 1850, stated that halibut were then very abundant in that locality, and that the cod-fishing vessels which visited Davis' strait every season used them to bait their hooks, though the supply far exceeded the demand for this purpose.

Sutherland narrates that on the return of the Penny expedition, in 1851, when crossing the Arctic circle, in longitude 53°, the sailors put over lines baited with pork and hooked a cod and a halibut at the depth of forty fathoms.

The most northern occurrence of the halibut on the western side of Davis' strait is that recorded by Mr. Ludwig Kumlien, naturalist of the Howgate expedition, who saw a large individual taken by the Eskimos off the mouth of Davis' straits, near latitude 64° north.

Richardson, in the Fauna Boreali-Americana, speaks of the occurrence of the species on the Greenland coast, but seems to have no authentic information of its having been observed even as far north as Labrador on the opposite side.

There is no reasonable doubt that the halibut is found along the entire eastern coast of Labrador, though there is no other published record of its occurrence north of Red bay, in the Straits of Belle Isle, near latitude 51° 40′ north, where it was observed by Mr. Horatio R. Storer, several individuals having been taken during his stay at that place in the summer of 1849.

It is abundant in certain parts of the Gulf of St. Lawrence, especially the island of Anticosti, and is also found along the entire coasts of Newfoundland and the eastern shores of Nova Scotia.

In June, 1878, the schooner *G. P. Whitman*, of Gloucester, caught a fare of halibut in two to twelve fathoms of water near Green point, Newfoundland. The crew said that they could see the fish lying on the bottom in shallow water.

Capt. George Olsen, schooner *Proctor Brothers*, arrived at Gloucester, August 2, 1880, with 22,000 pounds' weight of fresh halibut from Anticosti. He reported halibut plenty then at the western end of the island close inshore—within half a mile; he saw the halibut sporting near and on the surface; he found they would not bite, as on the banks, at halibut bait, and since fresh herring or capelin could not be obtained, could only get a partial trip of halibut. They were good fish, weighing sixty to eighty pounds.

According to M. H. Perley halibut are found in the Bay of Fundy up to its very head, where they are taken in summer in Cumberland bay, near the light-house off Apple river, and also in West bay. He states that they are also found on the south shore of the Bay of Fundy, and abundantly from Cape Split to Brier island, as well as in the Annapolis basin. Perley's report was prepared in 1852, and there is no evidence of diminution in that region since he wrote.

Mr. J. Matthew Jones tells me that halibut are occasionally

taken at Five islands in the Basin of Minas, but that this is of rare occurrence.

I am indebted to Captain Ashby for the following facts about the southern limits of the distribution of the halibut: He has never known them to be found south of Sandy Hook, where large ones are occasionally taken in winter. In May, 1876, the schooner *Cartwright*, fishing ten miles south-east of Montauk point, caught many halibut. In February, 1876, some Noank smacks caught a few halibut about eight miles from land, off the south-east point of Block island. Within the last forty years one or two halibut have been taken off the outer shore of Fisher's island. He has never known any to be taken in Long Island sound. Halibut are sometimes taken in three fathoms of water among the breakers off Nantucket, in "blowy weather." Forty years ago they were abundant about Gay head and Noman's land. There has been no systematic fishing there lately, but some individuals have probably been taken.

The local papers chronicled the capture, on May 1, 1876, off Watch hill, Rhode Island, of an eighty-pound halibut, the first taken in that locality for many years.

A halibut is occasionally taken along the shores of Maine and Massachusetts, but so seldom that a capture of this kind by one of the inshore fishermen is always mentioned in the local papers.

Abundance.—Half a century ago the halibut was extremely abundant in Massachusetts bay, and striking stories of their great plenty and voracity are narrated by some of the early fishermen of Cape Ann. Of late years, however, few have been found except in deep water on the off-shore banks.

Captain Chester Marr says that in early days halibut were exceedingly abundant on George's bank. He has seen a "solid school of them as thick as a school of porpoises" feeding on "lant." At another time "the whole surface of the water as far as you could see was alive with halibut; we fished all night and we did not catch a single codfish. The halibut would not let the hook touch the bottom; we caught 250 in three hours; the crews of some vessels would go and cut the fins off the fish and let their bodies go. No wonder that they were broken up. We thought they were always going to be so. Never made no calculations that we were going to break them up. The southern

side of George's was a kind of 'mother-place' for fishing halibut." There was no great abundance of halibut on George's after 1848.

The abundance of the species on the off-shore banks before the over-fishing took place is almost beyond credence. The following is selected from a large number of instances of fishermen's successes: The schooner *Mary Carlisle*, of Gloucester, made nine trips to the banks in 1871. Her catch was 350,188 pounds of halibut and 58,759 pounds of codfish; her net stock amounted to $17,275.53 for about eleven months' work, from December 27, 1870, to November 21, 1871. On one trip in the spring she brought in 58,553 pounds of halibut and 6900 pounds of codfish, her net stock reaching the sum of $4738.75, and her crew sharing $236.25 each from a voyage of thirty-four days. She had ten men in her crew, each of whom during the season shared $858.62. In three years this vessel stocked a total of $46,871, divided as follows: 1869, $17,549; 1870, $12,047; 1871, $17,275.53.

The presence of so important a food-fish in America did not long escape the observations of the early English explorers. Captain John Smith, in his History of Virginia, wrote: "There is a large sized fish called hallibut, or turbut: some are taken so bigg that two men have much a doe to hall them into the boate; but there is such plenty, that the fisher men onely eat the heads & finnes, and throw away the bodies: such in Paris would yeeld 5. or 6. crownes a peece: and this is no discommodity."

The halibut is surpassed in size by only three fishes on the Atlantic coast—the swordfish, the tunny and the tarpum. It is said, by experienced fishermen, that there is a difference in the size of the two sexes, the females being much the larger; the male, they tell us, rarely exceeds fifty pounds in weight, and is ordinarily in poor condition and less desirable for food. The average size of a full-grown female is somewhere between 100 and 150 pounds, though they are sometimes much heavier. Captain Collins, who has had many years' experience in the Gloucester halibut fishery, assures me that he has never seen one which would weigh over 250 pounds, and that a fish weighing over 250 pounds is considered large. There are, however, well authenticated instances of their attaining greater dimensions. Captain Atwood, in a communication to the Boston Society of Natural

History in 1864, stated that the largest he had ever taken weighed, when dressed, 237 pounds, and would probably have registered 300 pounds when taken from the water. In July, 1879, the same reliable observer saw, at Provincetown, two individuals taken near Race point, one of which weighed 359 pounds (302 pounds when dressed), the other 401 pounds (322 pounds when dressed).

There is a tradition in Boston that Mr. Anthony Holbrook, one of the early fish-dealers of that city, had in his possession a halibut, taken at New Ledge, sixty miles south-east of Portland, which weighed over 600 pounds. This story, which is recorded by Storer in his "Fishes of Massachusetts," Captain Atwood believes to be untrue. Halibut weighing from three to four hundred pounds, though unusual in comparison with the ordinary size, are by no means rare. I have before me records of ten or twelve such fish captured on the New England coast during the past ten years. Nilsson, has mentioned the capture, on the Swedish coast, of an individual which weighed 720 pounds. There are stories of halibut ten feet in length; a fish weighing 350 pounds is between seven and eight feet long and nearly four feet in width. The largest halibut are not considered nearly so good for table use as those of less than 100 pounds weight. A fat female of eighty pounds is, by good judges, considered to be in the highest state of perfection, while males are not so highly esteemed. Small halibut, known as "chicken halibut," ranging from ten to twenty pounds, are much sought after by epicures, and bring a high price in the New York and Boston markets. They are, however, comparatively rare, and those weighing ten pounds or less are rarely seen; the smallest recorded from our coast was about five inches in length, and was taken by Professor Verrill in a dredge-net in the Strait of Canso.

The halibut of the Pacific are apparently similar in dimensions to those of New England. Mr. Anderson, inspector of fisheries for British Columbia, states that in the waters of Puget sound they attain a weight of 200 pounds.

The wholesale dealers of Gloucester, in buying fresh halibut from the fishermen, recognize two grades; one, which they call "gray halibut," they consider to be of inferior value, and pay a lower price for. The gray halibut are distinguished by dark cloudings or blotches upon the under side, which in the most

marketable fishes are pure white. Almost all the largest halibut are classed among the grays. Fishermen claim that there is no actual difference between the gray and white fish, and it is a fair question whether they may not be right.

Migrations.—It is useless to attempt to describe at this time the migrations of the halibut from place to place; although much information has been received upon this subject, the problem requires long and careful study.

Captain Benjamin Ashby, of Noank, Connecticut, who is familiar with the fisheries south of Cape Cod, informs me that halibut frequent the deepest water in the spring and fall, and that in May and June they come up in the shoal water, in sixty or seventy fathoms, while in July they begin to go out again into deep water, and by the latter part of the month are on the way into the gully near the north-east part of George's bank.

Captain Joseph W. Collins, undoubtedly the best authority upon the subject, briefly expresses his views as follows: "Halibut are found in the deep water—say from 100 to 250 fathoms in depth—on the edge of all the banks from George's to the Grand bank the year round. Sometimes, however, they seem to be more numerous in comparatively shallow water in the winter and early spring. This was the case in the winters and springs of 1875–'76 and 1876–'77, as well as in the year preceding, but in 1878 there was no great catch of halibut in less than 100 fathoms on any of the banks. The great schools that were found in the western part of the Grand bank in February and March, 1876 and 1877, appeared to be migrating. The fish that were found to the south of latitude 44° north were mostly small-sized white halibut. They went off the bank into deep water, and nobody knew what became of them. Those that were caught to the north of this parallel were mostly large gray fish, and were traced as far as Saint Peter's bank. These are possibly the same fish—they are certainly the same kind of fish—that struck in on the western coast of Newfoundland and in the summer months in pursuit of capelin."

Capt. George A. Johnson states that the large halibut generally frequent the outer and deeper part of the banks, while the little "bull fish" lie inside, on shallower ground, and are caught on the inner end of the trawl lines; sometimes, however, the large halibut also come up on the shallow grounds.

On the coast of Newfoundland, Anticosti and Labrador, in summer, halibut frequently run inshore after capelin. When in shallow water near the shore they are usually wild and very active. Within eight years the fishermen have extended their fishing much farther out to sea; previous to that time the greater part of the halibut were taken on top of the Grand bank in thirty to fifty fathoms of water, but after the beginning of April the fish went elsewhere, and the fishermen lost sight of them. They soon learned, however, to follow them down the slopes of the banks, though before 1876 they had rarely fished in water deeper than seventy to ninety fathoms. Since that time, as has already been stated, fishing has been carried into twice or three times that depth. All that can at present be said in explanation of their movements is, that they occur in great schools, which consume the available food in any one locality, and are soon obliged to shift their position to some other place where they can find fresh supplies. It does not seem possible that their migrations can be caused by conditions of temperature or are in connection with their breeding habits. During the breeding season the schools sometimes remain for months in one locality, and these places are generally of limited extent. While spawning but little if any food is found in their stomachs.

Food.—They are large-mouthed, sharp-toothed and voracious, and though especially adapted for life upon the bottom, doubtless feed largely upon crabs and mollusks. They are especially fond of fish of all kinds; these they waylay, lying upon the bottom, invisible by reason of their flat bodies, colored to correspond with the general color of the sand or mud upon which they rest. When in pursuit of their prey they are active, and often come quite to the surface, especially when in the summer they follow the capelin to the shoal water near the land. They feed upon skates, cod, haddock, menhaden, mackerel, herring, lobsters, flounders, sculpins, grenadiers, turbot, Norway haddock and bank clams. Captain Ashby tells me that common flounders and flat fish are among their most favorite food; these they follow upon the shoals of George's and Nantucket, lying in wait for them on the sand-rips and seizing them as they swim over. He has seen half a bushel of flat fish stowed away tightly in the stomach of a single halibut. He has often seen halibut chasing flat fish over the surface of the water. About Cape Sable their

favorite food seems to be haddock and cusk. He has seen eight or ten pounds of haddock and cod taken out of one of them. When they are on the shoals they are sometimes filled with flat fish, haddock, cusk, sculpin and herring, but when in deep water he has found very little food in them. They eat crabs and other crustaceans, but shells are rarely found in their stomachs, except those of clams and mussels.

Captain Hurlbert tells me that when the vessels are dressing codfish on the Grand banks, and the backbones and head are thrown overboard, these are frequently found in the stomachs of halibut taken in the same locality.

Mr. William H. Wonson, of Gloucester, has seen live lobsters six inches long taken from the stomach of a halibut. Captain Mar states that they feed on whiting, mackerel and herring. He remarks: "Halibut will drive off any kind of fish and take charge of the ground."

At the meeting of the Boston Society of Natural History, in 1852, Dr. W. O. Ayres stated that he had seen a block of wood, a cubic foot in dimensions, taken from the stomach of a halibut, where it had apparently lain for a long time. Capt. George A. Johnson found an accordeon key in one of them. Olafson, in 1831, studying them on the coast of Greenland, found not only pieces of iron and wood in their stomachs, but in one individual a large piece of floe ice. Captain Collins has observed that they often kill their prey by blows of the tail, a fact which is very novel and interesting. He described to me an incident which occurred on a voyage home from Sable island in 1877: "The man at the wheel sang out that he saw a halibut flapping its tail about a quarter of a mile off our starboard quarter. I looked through the spy-glass and his statement was soon verified by the second appearance of the tail. We hove out our dory and two men went in her, taking with them a pair of gaff-hooks. They soon returned bringing not only the halibut, which was a fine one of about seventy pounds weight, but a small codfish which it had been trying to kill by striking it with its tail. The codfish was quite exhausted by the repeated blows, and did not attempt to escape after its enemy had been captured. The halibut was so completely engaged in the pursuit of the codfish that it paid no attention to the dory, and was easily captured."

The observations of the halibut fishermen are full of interest

to the naturalist, and it is from them that we derive all our knowledge of the habits of the animal while feeding. The halibut, following in after the schools of capelin which visit the shores of Western Newfoundland, Southern Labrador and the islands of Anticosti and Miquelon to spawn, have often been found in great abundance in very shallow water, not above five to ten fathoms deep.

Fishermen who have watched halibut under such circumstances, and have been able to see them perfectly well in the clear water, state that these fish exhibit marked peculiarities in biting at baited hooks on a trawl. The halibut will advance to the bait, apparently smell of it, and then retreat four or five feet from it, always lying on the bottom, head toward the bait, as if watching it. After repeating this performance several times—generally three or four—the fish seems to make up its mind to eat the bait, and suddenly darting toward it, swallows it down with a gulp.

The George's hand-line fishermen believe that halibut often strike the baited hooks with their tails. It is not uncommon on board a George'sman to hear a fisherman remark: "There's a halibut around; I felt him strike my gear." When a halibut has announced his presence in this way it is scarcely necessary to say that every effort is put forth by the fisherman to attract the fish to his hooks, and if a man is sufficiently skillful he generally succeeds in capturing the fish.

There is much rivalry in a vessel's crew when it is known that halibut are on the ground where she is lying, and every known device is adopted to entice the fish to bite at the hooks. Strips of newly-caught haddock, with fresh blood still on them, are considered the best bait. Two, three, or more of these are put on a hook, which is passed through the thickest end of the strips, while the pointed ends of the bait are left to float about in the water. Where there is a tide running these closely resemble the movements of a small fish. The hooks are usually "pointed" with herring bait. After the bait is on the hooks many fishermen add (as they believe) to its attractiveness by mopping it in the slime of a halibut, if one has been previously caught. This is done by wiping the baited hook back and forth over a halibut. The lure thus prepared, the fisherman lowers his apparatus to the bottom, and by a skillful manipulation tries to induce the fish to bite. Sometimes he will let the tide sweep his "gear" along the bot-

tom, and again he will endeavor to give his baits the appearance of life by slowly pulling them up a short distance from the ground. If he finally succeeds in hooking a halibut, all his art is required to bring the fish to the surface and land it safely on deck. If it be a large fish it almost invariably makes a desperate fight to escape. It may, perhaps, come up easily for ten or fifteen fathoms, when it suddenly takes a plunge downward. Surge! surge! goes the line through the hands of the fisherman, who knows very well that he must "play" his fish or else his line will be snapped like pack thread. This operation may be repeated several times, and it is not uncommon for a large and particularly "wild" halibut to go almost to the bottom after having been hauled nearly to the surface of the water. At last the fish is alongside, and the shout of "Gaffs! gaffs here!" brings two or three of the nearest men to the side, armed with long-handled gaffs. If the fish is exhausted the gaffs are quickly hooked into his head and he is dragged unceremoniously over the rail and falls with a heavy thump on deck, which usually resounds with the strokes of his powerful tail until he is stunned by repeated blows with a killer. If the halibut is still active when he comes alongside, much dexterity is required to gaff him. He makes desperate attempts to escape, and thrashes the water into foam with his tail.

When the fish is on deck and killed, his captor cuts his mark in a conspicuous manner, generally on the white surface of the halibut, which is the underneath portion when the fish is in the water, but is invariably turned upward after it is taken on deck; this method being adopted to prevent the blood from settling on that side and thus making the fish look dark colored or gray. The George's fishermen frequently bleed their halibut by making a cut across the tail.

Halibut caught in shallow water are exceedingly active, and frequently make a hard fight. When a fish of 100 to 200 pounds weight is raised from the bottom on a trawl, he usually starts off at great speed, making the dory spin around in his effort to escape. Of course he cannot run far in one direction, for the weight of the gear is too much for him to drag over the bottom. After a while he is sufficiently tired out to be hauled alongside of the dory, and if the fisherman is expert enough to hit his fish two or three smart raps over the nose with a "killer," the halibut

succumbs and is pulled into the boat. It is often the case, however, that considerable difficulty is experienced in effecting the capture of a large fish, and it is by no means an unusual circumstance for one to escape.

A fisherman related to me an incident which he witnessed in the shallow water near Miquelon beach, Newfoundland. Two men were out hauling a trawl in about seven fathoms of water, a short distance from the vessel. They worked along quietly for a while, when suddenly the dory started off at a tremendous speed, towed by a big halibut which had been started from the bottom, and which, in its efforts to escape, darted about wildly, pulling the boat after it and careening her at a considerable angle. By dexterous management it was, after a while, brought to the surface; the man aft quietly pulled up on the ganging until the fish broke water, when an iron gaff was driven into its head. The doryman had made the mistake of gaffing his fish before it was stunned, and as a result, no sooner was the gaff in the halibut than the latter made a tremendous splurge, twisted the implement out of the fisherman's hand, and, getting a fair start, made a run to the bottom. Another quarter of an hour was required to again get it alongside of the dory. This time there was no gaff, and to serve in its place the doryman had cast off the trawl anchor from the buoy-line. When he got the halibut's head above water he drove the fluke of the sixteen-pound anchor into the fish, which he made sure he would hold that time. But he was mistaken. The halibut, as before, escaped, taking with it the anchor, almost pulling the man out of the boat, which was nearly capsized, and going off with the hook, too, which this time it tore from the trawl.

The halibut, in its turn, is the prey of seals, of the white whale and of the various large sharks, especially the ground shark, or sleeping shark, in the stomachs of which they have sometimes been found; their sides, I am told by Captain Collins, are often deeply scarred, probably by the teeth of the sharks, or in their early lives by mouths of larger individuals of their own kind.

Spawning.—There is great diversity of opinion regarding their spawning season. Some fishermen say that they spawn at Christmas time, in the month of January, when they are on the shoals. Others declare that it is in summer, at the end of June. Capt. George A. Johnson, of the schooner *Augusta H. Johnson*, of

Gloucester, assures me that halibut "spawn, just like the human race, at any time of the year." In April, 1878, he was fishing on Quereau bank and found large and small halibut, the large ones full of spawn. In May he was on Le Have bank, where he found only small male fish full of milt; in June he was on Le Have again, fishing in shallow water, where he found plenty of "small bull fish, with their pockets full of milt;" in July he was again on Quereau bank, where he found a school of small and big male and female fish, all apparently spawning or ready to spawn, "with milt and pees soft;" in August he was on the outer part of Sable island, where he found females full of spawn.

Captain Ashby, speaking of the halibut on George's banks, states that roe is always found in them in May and June. The roes of a large halibut caught by him in 1848 on the south-west part of George's, and which weighed 356 pounds, after it had been dressed and its head removed, weighed 44 pounds. He states that the halibut in this region have spawn in them as late as Connecticut vessels continue to catch them, or until September. He has seen eggs in halibut of twenty pounds weight, and thinks they begin to breed at that size. The spawn of the halibut is a favorite food of the fishermen of Southern New England, though never eaten by those of Cape Ann.

Captain Hurlbert, of Gloucester, tells me that on the Grand banks of Newfoundland the spawning halibut school used to come up in shoal water in forty or fifty fathoms. In August, 1878, he found many with the spawn already run out. At that time several Gloucester fishermen reported that the halibut on Le Have and Quereau banks were full of spawn. Captain Collins told me that in July and August, and up to the first of September, they are found here with the ovaries very large, and are often seen with the ova and milt exuding. The ovaries of a large fish are too heavy to be lifted by a man without considerable exertion, being often two feet or more in length. At this time very little food is found in their stomachs. In September, 1878, the Fish Commission obtained from Captain Collins the roes of a fish weighing from 190 to 200 pounds, taken by the schooner *Marion* on the 13th of the month on Quereau bank. This fish was taken at the depth of 200 fathoms, and the temperature of the water was roughly recorded at 36° F. These ovaries were put into a basket with ice and brought to the laboratory of the Fish Com-

mission, where they were found to weigh seventeen pounds two ounces. Part of the eggs were nearly ripe, and separated readily, while others were immature and closely adherent to each other. A portion of the roe, representing a fair average of the size of the eggs, was weighed, and was found to contain 2185 eggs; the weight of this portion was two drams. The total number of eggs was from this estimated to be 2,182,773. It is not yet known whether the eggs float or rest upon the bottom, nor is it known how long is the period of incubation, nor what is the rate of growth of the fish. As has already been mentioned, young fish are very unusual; the smallest ever seen by Captain Ashby in Southern New England was taken on Nantucket shoals, and weighed two and a half pounds after it had been eviscerated.

Abnormal individuals.—"Left-handed halibut" are sometimes taken. Perhaps one out of five thousand is thus abnormal in its form, having the eyes upon the left rather than upon the right hand side of the head.

Halibut with dark spots or patches on the under side, of the same dark color as the back, are occasionally taken. These are called by the fishermen "circus halibut." They are generally of medium size and thick, well-fed fish.

The history of the halibut fishery has been a peculiar one. At the beginning of the present century these fish were exceedingly abundant in Massachusetts bay. From 1830 to 1850, and even later, they were extremely abundant on George's banks; since 1850 they have partially disappeared from this region; the fishermen have recently been following them to other banks, and since 1874 out into deeper and deeper water, and the fisheries are now carried on almost exclusively in the gullies between the off-shore banks and on the outer edges of the banks in water 100 to 350 fathoms in depth. The species has in like manner been driven from the shallow fishing grounds on the coast of Europe; there is, however, little reason to doubt that they still are present in immense numbers within easy access off the British and Scandinavian coasts, and that a good fishery will yet grow up when the fishermen of those countries shall have become more enterprising.

A Prophecy.—In the year 1879 there were forty vessels, of 3168 tons, from Gloucester, Mass., employed exclusively in the fresh-halibut fishery; also vessels hailing from New London and the eastern end of Long island are employed, except during the

winter months, chiefly in the capture of halibut, which they carry to New York. These vessels, however, take also a considerable quantity of codfish. In addition to the Gloucester vessels already mentioned, which fish for halibut throughout the year, there were eight vessels, of 647 tons, which fished for halibut in the winter season and engaged in other fisheries, generally the cod fishery, from May to November.

The vessels of the George's fleet, though their chief object is the capture of cod, take considerable quantities of halibut, which are brought to Gloucester fresh; a few also are sometimes taken by the Western bank cod fleet, and a still smaller quantity by the Boston market fleet. In 1879, and probably in 1880, there were a few small vessels on the coast of Maine which engaged in the fresh-halibut fishery for three or four months in the summer, carrying their fish chiefly to Portland. The total catch of halibut on the New England coast for 1879 is estimated at 14.637,000 pounds, distributed as follows:

Gloucester halibut fishery	8,300,000
Gloucester vessels fishing in winter only	1,000,000
New York halibut catchers	3,000,000
Gloucester, George's fleet (incidental)	2,000,000
Western bank cod vessels (incidental)	37,000
Small vessels on the coast of Maine and Massachusetts	300,000
Total	14,637,000

In 1885 the halibut fleet of Gloucester is reduced to one-fourth of its former size, and the total catch is estimated at from three to five million pounds.

It is evident that within a few years the American off-shore halibut grounds will be so depleted that the fresh-halibut fishery on our coasts will be abandoned. We shall then derive our chief supply from the waters of Greenland and Iceland, where several vessels go each year to bring back cargoes of salt "flitches." Halibut will come into our markets only in a smoked condition, and the species will be as unfamiliar in our fish-markets as it is in those of the old world. The life-history of the species must be recorded now, for it can never be made so completely hereafter. This is the writer's excuse for having presented in this place so full a biography of the halibut.

——:o:——

TRACES OF PREHISTORIC MAN ON THE WABASH.

BY JOHN. T. CAMPBELL.

DURING the year 1884 I was employed as civil engineer for the construction of a levee from the mouth of Big Raccoon creek on the east side of the Wabash river, which is the west boundary of Parke county, Indiana. The levee was built as close to the river bank as practicable, and was aimed to be the height

of the highest bottom land, though this is about seven feet below the highest floods, such as occurred in the summer of 1875 and winter of 1883. There is one very high bottom about four and a half miles south of the mouth of Raccoon creek, locally known as Blue Grass landing. Forty to fifty years ago this place was well known to flat and steamboat men. The Wabash was then the great commercial thoroughfare for all this country, and this being a good landing, backed by good farms near by, and covered with the heavy, green carpet of blue grass (*Poa pratensis*), was also one of the most beautiful spots on the river. Here it was, according to Dr. Collett, State geologist, report of 1879, that the Kentucky soldiers of Harrison's army, while marching from Fort Harrison to Tippecanoe to fight the Indians there, found the original Kentucky blue grass, and on their return gathered and carried home the seed, which is now an important article of Kentucky commerce.

The old settlers had a tradition that this spot (a quarter of a mile long up and down the river) was an ancient Indian camping ground. What reasons they had for so believing I never learned. But during my frequent surveys and inspections of the work before mentioned, I had abundant reason to know that such was the fact. The surface of the ground, however, indicates nothing of the kind. The place is not overflowed more than once in seven years on the average. The bottoms are over a mile wide, and much the lowest back next the hills. The few floods that have overflowed this high bank during recent years (I mean historically recent, not geologically) have flowed nearly square across it, and since the timber has been cut away, has washed small channels from four to ten feet deep toward the eastern hills. These channels are deepest next to the river, growing shallower till they disappear at distances from one-quarter to three-quarters of a mile from the river. In the bottom of these channels Mr. Samuel D. Hill, drainage commissioner of the county, was the first to observe little heaps composed of stones about the size of apples or potatoes, and about a bushel in quantity. They were in the more recently cut channels, the current being sufficient to remove the bottom earth but not enough to disturb the order of the stones. I said the stones were in heaps; this is not quite correct. They were about three layers deep and two and a half to three and a half feet wide, and slightly oval in shape. They were

underlaid with one to three inches of charcoal, and on top of the stones, and scattered down streamward from them, were mussel shells and a few bones of small animals too much decayed and fractured to be identified; but the leg of a crane or pelican near by was so well preserved that every joint of the foot to the nail was in perfect shape. But on handling it soon crumbled into lime dust. So it was with the mussel shells, except a half shell, which was as fresh as if taken recently. The stones were such as lie at the upper end of the river bars, mostly crystalline, some gray, others blue. All had originally been smooth, water-worn, but were broken into angular fragments, segments, cubes and zones. I put the pieces together in several instances and with them completed (filled out) smooth, rounded water-worn stones. All had a dark smoky look as if having been burned in the fire. I should think that those we examined and those we saw without special examination would amount to seven cubic yards. One piece of white limestone, about the size and much the shape of a brick, when I touched it I found to be slaked into lime.

The charcoal underneath the layers of stones on the coal, their smoky appearance, their peculiar fractures, all show that they had been placed on a fire. The mussel shells and bones on and near these stones indicate that the purpose of that fire was for cooking. It is very difficult to open the shells of a live mussel (Wabash oyster), but when baked on hot rocks they easily yield.

I say these stones were found in heaps. Such was true of five separate piles or heaps, from which I infer that all the stones found in the largest and oldest channel had been once so piled, as they were smoked and broken in the same way, and seemed to amount in quantity to ten wagon loads or about seven cubic yards.

When were these stones piled and used as above described? "That is the question." This place or piece of bottom is very seldom overflowed now, consequently it is building up from sedimentation very slowly. The heaps, or piles of stones were found about five feet beneath the present surface, and on the present surface bur oak trees are standing that are two hundred and fifty years old. These grew from acorns borne by a previous generation of trees, and the acorns from which they grew, judged by the surface roots of the trees, were not more than two feet beneath the present surface of the ground. The under side of the surface roots would be a little below the position of the acorn when the

tree started. It is my judgment that not less than five hundred years have elapsed since these stones were covered by sedimentation, and I should think the time would not exceed one thousand.

As stone axes, knives and arrow-heads were searched for among these stones and not found, I think they were not used by the people who used the stones for cooking. Among so many stones of that kind, and in a camp, some tool would have been dropped. Such tools are found on the present surface in every neighborhood about here. If this should prove correct (that none were used by this people), it would prove that the stone axe is not so old as we have heretofore thought it to be. Or, did these people take extra care of their tools? Then why did the much later Indians having equal use for *their* tools, drop them all over the country? Or, were these suddenly abandoned on the introduction of steel tomahawks, knives and fire arms?

There are no Indian mounds within fifty miles of this camp. It was, therefore, hardly the work of the mound-builders. My ancestors for three generations were pioneers, and well acquainted with Indian character and customs from 1760 to 1820, and from Massachusetts to the Wabash, and while I have heard very many of their Indian stories I have never heard of their seeing anything like what I have described, nor do I remember to have seen it described in any account I ever read. Is this a new feature of an ancient subject? or am I illy informed on it?

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

——The session of the American Association for the Advancement of Science for 1885 has just adjourned its session at Ann Arbor, Michigan. The meeting presented many admirable features. Other things being equal, a university town has superior advantages for the conduct of scientific gatherings. The spirit of the place is congenial. Facilities for presentation and illustration are at hand. The university buildings furnish excellent assembly rooms. The social conditions are appropriate and not distracting. Such were the circumstances which attended the late meeting, and the members experienced their benefits to the full. The number of members in attendance (510) though smaller

than at many previous meetings, may be safely asserted to have embraced a larger percentage of the scientific element than they. Although the number of papers read (175) was smaller than at some preceding meetings, the quality, in many of the sections at least, was exceedingly good. If it were possible we should prefer that the American Association might always meet beneath the shadow of a university, and in a town like Ann Arbor, whose *raison d'etre* consists of the university which it contains. But such towns are rare in the United States, and we cannot expect to be always surrounded by the favorable conditions of the meeting which has just closed its sessions.

—— The controversy over the question whether the human embryo has a genuine tail like that of the embryo of other mammals, has been nearly set at rest by the painstaking researches of Professor Fol, of Geneva.

We have translated his article from the reprint in the *Journal de Micrographie* for June, and the reader may for himself see how this skilled histologist has proved the presence for a short period in embryos in the fifth and sixth week of their development, of four embryonic vertebræ, which after the sixth week fuse together; the tail itself at first elongated and regularly conical, becoming shorter and more rudimentary. Professor Fol, in closing, simply contents himself with remarking that the embryo human tail well deserves the name, and that the organ "evidently deprived of all physiological utility, should be classed in the number of representative organs."

This temporary, deciduous organ, which appears for only a brief period and still comparatively early in embryonic life, points unmistakably to the origin of man from some tailed mammal, whether a monkey, or some less specialized form, possibly allied to that generalized type, the lemur.

This instance is one of several others in the growth and structure of the human body which affords so strong circumstantial evidence of man's descent from some lower animal form, that it amounts, in minds trained to embryological, histological and anatomical methods, to the strongest probability.

—— The death of that veteran French naturalist, Henri Milne-Edwards, who at the great age of eighty-five passed away July 29, in his house in Rue Cuvier near the Jardin des Plantes, is a notable event in the history of biological science. Milne-Edwards

will be remembered as a physiologist for his discovery of the principle of the physiological division of labor, as well as his laborious and extensive work, in fourteen volumes, on comparative physiology and anatomy. But as a zoölogist his fame was wider. He was to France what Owen is in England and Agassiz was in America. His special anatomical memoirs were conspicuous examples of the skill and nicety in injection and dissection which characterized the Cuvierian school, his treatises on the organs of circulation of Crustacea being of marked beauty and value. His general zoölogical works were the Histoire Naturelle des Crustacés, published with the aid of Audouin, and with Haime, an extended work on corals. Biologists, being human beings, have a spice of dogmatism and sectarianism in their nature, and in a notice of the great French naturalist in an English scientific journal, it is stated that Milne-Edwards did not late in life change his views as to the origin of species. We never knew, however, of his publicly attacking champions of the new biology. In his son, Alphonse Milne-Edwards, the family name is not now less conspicuous than for the past fifty years as a leading one in French biological science.

—— The U. S. Coast Survey, which for so many years under the direction of Bache and others rendered such signal service to science while pursuing its legitimate work, has been clouded by alleged official misconduct. Charity will be felt for any one who suffers official punishment after life-long services to science and the public welfare. Long before the present civil service reform in politics, the Coast Survey was managed with singular ability and economy. Its work will go on as long as geological agencies produce changes, however minute, in our coast lines and harbor approaches, whether "a thousand years" or more. Our other scientific bureaus have certainly been conducted with far more ability and economy than some departments and bureaus filled by political appointments. Still, rigid economy and business tact will be demanded of our scientific directors and commissioners, as they have been in the past.

—— We have received the following:

Editor AMERICAN NATURALIST—Sir:—In the August issue of your magazine you state: "If the bureaus of the Government would send their return receipts with or in the publications they issue, every one concerned would be greatly accommodated. The return receipts would then be promptly returned, whereas as now sent at another time, it requires time and trouble to identify the package referred to, which sometime results in a failure to return the receipt as desired."

Pardon me if I suggest that the above criticism has been made without due reflection. First, experience demonstrates that the receipts sent with the volumes are returned in a much smaller

per cent than if sent in special letters at other times. Second, if the receipt is sent with the book and the book is lost, the receipt is lost. If the receipt is sent in a separate, special letter, the author expects the book, watches for its arrival, and if it does not come informs the office, and usually in time so that the book may be immediately traced through the mails.

On all accounts it is better to send the receipt by a special letter independent of the book itself, and in advance of the book.

I am, yours cordially,

J. W. POWELL.

Our readers now have both sides of the question. Our own experience as to the ease of returning receipts, differs from that of the distinguished director of the U. S. Geological Survey. But if the department is satisfied with the system no one else need complain.

——:o:——

RECENT LITERATURE.

FORBES' A NATURALIST'S WANDERINGS IN THE EASTERN ARCHIPELAGO.[1]—Though inferior in general scientific interest and literary execution to Wallace's Malay Archipelago, Mr. Forbes has produced an excellent book of travels, which we have read with much interest. Most of the islands visited by Wallace were also visited by our author, but the routes of the two travelers were in each island different. The book, as the author modestly states, is a transcript of the more interesting of the field-notes made during his wanderings, and is to be "considered" in the light of an addendum to Wallace's "model book of travel."

Besides his observations on the formation of the Cocos-keeling islands and numerous entomological and ornithological notes, the matter largely relates to the botany of these islands, as well as the manners and customs of the natives and mixed races with whom Mr. Forbes was in constant contact. No detailed account of the Timor-laut islands has appeared before that of Mr. Forbes, and little has been published on the inhabitants of the interior of Timor; and, by the way, a residence in Timor, owing to the deadly fever of the coast and the continual warfare between the different villages, was not found to be particularly comfortable. Indeed, considering coast fevers, insect pests, venomous animals, not to mention an occasional tiger, thieving natives, the liability of meeting Malays "running a muck," the jealousy and selfishness of native officials, and tropical heats, rains, earthquakes and an occasional volcanic eruption or cyclone, a naturalist's life in the East Indian archipelago has its lights and shades.

[1] *A Naturalist's Wanderings in the Eastern Archipelago.* A narrative of travel and exploration from 1878 to 1883. By HENRY O. FORBES, F.R.G.S., etc. With numerous illustrations from the author's sketches and descriptions, by Mr. JOHN B. GIBBS. New York, Harper & Brothers, 1885. 8vo, pp. 536.

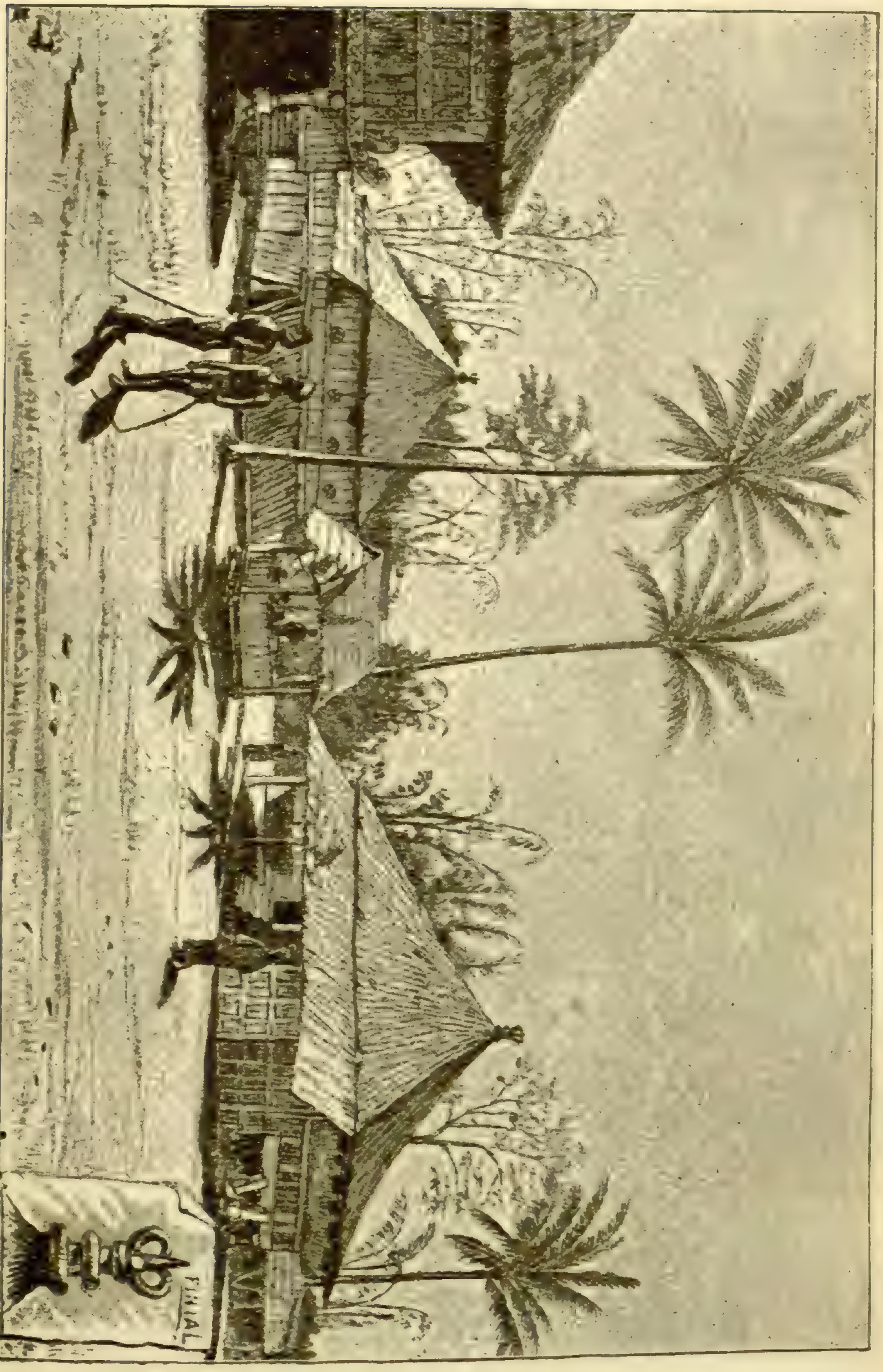
Mr. Forbes' notes and conclusions as to the origin of coral reefs are of interest, as the subject is now under fresh discussion. Visiting the Keeling atoll nearly fifty years after Darwin, he found that the encroachments of the sea on the land "had not increased at all; on the contrary, it struck me that the land was gaining on the lagoon." Between Direction island and Workhouse island he observed what seemed to him signs of recent elevation. His conclusions are in the following words: "I incline to believe, therefore, that the Keeling-reef foundation has arisen as Murray, Semper and Agassiz have suggested; but that its islets have been the result of the combined action of storms and the slow elevation of the volcanically-upheaved ocean floor on which the reef is built."

Among the notes on mammals is an explanation, new to us, of the use of the upturned and hooked teeth of the hog-deer (Babirusa). They are used, he was told by the natives, "to hold to the bottom of ponds by, when hard pressed by hunters."

The author's journey by raft, or rakiting, down the Musi river to Palemberg was remarkably interesting, and the following extract will convey an idea of our author's powers of description when at his best, for at times his style is slovenly and ungainly:

"To recall the magnificent flora of the upper reaches of the river almost makes me retract the statement that the tropics present few flowers; for so blossom-spangled a road it would be difficult to match anywhere;—it is only in the beginning of the wet season, however, and along the steep banks of some such river, wide enough to let in the sunlight and the free breath of heaven, that one must look for, or indeed expect to be able to see such a display. The singular trackless streets, roads and paths of water by which I rambled among the forest avenues are never-to-be-forgotten reminiscences; nor lower down the slow majesty of the widening river between its level banks fronted with tall reeds, dark-foliaged figs, and groves of Eriodendron trees, with their stiff trifid arms; and at last the broad expanse of its united affluents, by whose sources I had for so many months encamped, drawing towards itself the atoms of produce of two degrees of latitude, and concentrating them into a hot nucleus of commercial life and activity. Intermingled with all these memories are a thousand indescribable vignettes; miniatures of quaint works and sandy bays and embossed villages, of out-of-the-world ways and habits and customs, of the intermittent comers and goers; of the changing features of the river's face itself in wind and rain, in early morning or noonday sun, in evening shades, under the pale moon, and in the solemn silence of the darkness. Surveyed from my window in the intervals of occupation, or seated under the veranda in the cool evenings, this changing landscape of days and days (so placid and imperceptible was to me the motion of our gliding down, and so full

PLATE XXXIV.



Village of Kenali.

PLATE XXXV.

Native of Wakolo Village, Lake Wakolo.

New species of Brugmansia, of the family of the Rafflesiaceæ.

of that exhilarating relief from labor and fatigue) seemed to move past my eyes of its own accord, and afforded me a continued and massive sensation of delight that nothing could disturb, and which can be but faintly conceived by those who have not experienced this uncommon mode of travel which is absolutely different from that by any other water-carriage."

Unfortunately Mr. Forbes lost large collections of plants, and the zoölogical novelties he obtained were not of special importance. Descriptions by various specialists of the new forms discovered are added in fine print, with lists of plants, among them a new species of Brugmansia of the family Rafflesiaceæ.

The illustrations of such a book should be attractive, but on the contrary all are some sort of process work and are exceptionally coarse and unsatisfactory, as samples on Pls. XXXIV–'VI. On the other hand the maps are frequent and well engraved.

THE REPORT OF THE FIFTY-FOURTH MEETING OF THE BRITISH ASSOCIATION.—One very tangible result of the last meeting of the British Association, held at Montreal in August and September, 1885, is a volume containing 980 closely-printed pages, besides more than 200 pages occupied by the table of contents, list of members, etc. More than forty reports upon the state of science, by various committees and individuals, and about 340 papers read in the various sections make a total too long for review, and the NATURALIST is therefore compelled to notice only a few of the papers read upon biological and geological subjects. Among these the report of Messrs. Etheridge, Woodward and T. R. Jones, upon the fossil Phyllopoda of the Palæozoic rocks (pp. 75–95), that of Messrs. Sorby and Vine upon the fossil Polyzoa (pp. 97–219), that upon the Zoölogical Station at Naples (pp. 253–263), that on the Archæan rocks of Great Britain, by Professor T. G. Bonney (pp. 529–551), and that upon the characteristics of the North American flora, by Professor Asa Gray (pp. 555–568) may be especially mentioned. A most thoughtful and pregnant article is the address of W. T. Blanford, president of the Geological Section. It deals with the startling exceptions to the rule that beds exhibiting "homotaxis," or similarity of fossil forms, are in reality contemporaneous. By a comparison with each other of the faunas of the Pikermi beds, of the Siwaliks, Gondwana and other fossiliferous strata of Hindostan, and of the Australian coal measures and associated beds, he proves that homotaxis or the want of it is not sufficient to prove the synchronism or lack of synchronism of beds situated in different parts of the world. No less than forty-eight papers were read in the Geological section, and are represented here by abstracts of moderate length.

The address of Professor H. N. Mosely, president of the Biological section, deals with the phenomena of pelagic and deep-sea life, the amount of oxygen, nature and quantity of food, zones of

depth, derivation of the abyssal fauna and other questions which the investigations carried on by the various deep-sea exploring expeditions have brought to the front. Among the remaining fifty-eight biological papers read, it will suffice to mention those of C. Spence Bate on the geographical distribution of the macrurous Crustacea, of P. H. Carpenter upon the geographical and bathymetrical distribution of the Crinoidea, and that of E. A. Schafer on the mechanism of absorption. Many of the papers which are here given in condensed form have also been published at full length in scientific periodicals.

VINING'S "AN INGLORIOUS COLUMBUS."[1]—This volume of more than 700 pages is devoted to the task of proving that Hwui Shan and four other mendicant Buddhist monks, who in 458 A. D. came from Afghanistan to China, and thence proceeded further to the east, really discovered America. The points brought out in favor of this idea are certainly very many and their cumulative force large.

Hwui Shan returned to China in the first year of the Ts'i dynasty, and told many marvelous stories concerning the countries of "Marked Bodies," "Great Han" and "Fu-sang" which he had seen on his journeyings, as well as about a "country of women," inhabited by females with hairy bodies and long locks, who carry their young on their backs and nurse them a hundred days. From the distances given, the size of the countries and resemblances in the habits of the natives, Mr. Vining concludes that the land of "Marked Bodies" is identical with the Aleutian islands, "Great Han" with Alaska, and "Fu-sang" with Mexico, while the hairy women are explained away into monkeys.

Many preceding authorities have noticed or translated Hwui Shan's recital, and Mr. Vining mercilessly quotes them all in the first portion of his work. This is very fair, but makes extremely wearisome reading. After these authorities comes an essay on the nature of the Chinese language, followed by Hwui Shan's text, which is accompanied by eight translations, including that of the author.

After pointing out various resemblances between Buddhism and the worship of Quetzalcoatl, parallelisms between the representations of that god and those of Gautama-Buddha, some curious word-likenesses and certain Mexican traditions which seem to contain intimations of Hwui Shan's visit, Mr. Vining does not forget to tell his readers that the fifth century was so long ago that considerable difference between Hwui Shan's description and the state of things known to us must be expected.

[1] *An Inglorious Columbus;* or evidence that Hwui Shan and a party of Buddhist monks from Afghanistan discovered America in the fifth century A. D. By EDWARD P. VINING. New York, Appleton & Co.

REPORT OF PROGRESS OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA FOR 1882–'83–'84.—This bulky volume is filled largely with matter relating to explorations in Central and Northeastern British America, particularly the region around Hudson's bay. Among the more valuable reports are those by G. M. Dawson on the region in the vicinity of Bow and Belly rivers, Northeast Territory; by Dr. Robert Bell on part of the basin of the Athabasca river, Northwest Terr., and the report of his observations on the Labrador coast, Hudson's strait and bay; while Mr. Ells and A. P. Low give the results of their explorations of the Gaspé peninsula. The geology of portions of New Brunswick is described by Professor L. W. Bailey, while the surface-geology of Western New Brunswick, especially the St. John valley, is reported on by Mr. R. Chalmers. Northern Cape Breton has been explored by Hugh Fletcher. Other reports are of economic interest, while the maps issued with the report form a separate atlas.

WALCOTT'S PALÆONTOLOGY OF THE EUREKA DISTRICT.—This well-illustrated quarto volume forms Vol. VIII of the monographs of the U. S. Geological Survey, and though received in July, 1885, bears date 1884. Heretofore the descriptions of Meek and others of Palæozoic fossils from the far West were based on small collections hastily gathered from more or less widely separated localities by Government exploring parties and field geologists. "We now possess," it is claimed in the letter of Mr. Hague transmitting the present work to the director of the survey, "the results of a careful survey of a district with a rich fauna, through 30,000 feet of Palæozoic strata, representing the Cambrian, Silurian, Devonian and Carboniferous rocks." By means of these fossils Mr. Walcott has endeavored to illustrate the stratigraphic succession and equivalency of the geological horizon in Central Nevada with those described elsewhere.

CURTIS' SILVER-LEAD DEPOSITS OF EUREKA, NEVADA.—This volume forms the seventh of the monographs of the U. S. Geological Survey. It is illustrated by sixteen plates of sections, etc., of the Ruby Hill mines, and the work appears to have been carefully prepared. The summary at the close of the volume, of results, will render the report accessible to miners and experts.

RECENT BOOKS AND PAMPHLETS.

Morris, C.—The primary conditions of fossilization. Ext. Proc. Nat. Sci. Phil., 1885. From the author.

Lesquereux, L.—The Cretaceous and Tertiary floras. U. S. Geol. Surv. of the Territories, Vol. VIII, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*African News.*—The Revs. G. Grenfell and T. J. Comber have contributed to the Proc. Royal Geog. Society an account of their explorations on the Congo. The Bochini or Kwa river was ascended for about 100 miles, and was proved, notwithstanding its apparent smallness, to receive the great river Qwango and also the Njali Pi, or Black river, coming from Lake Leopold II. Between Stanley Pool and the mouth of the Bochini the south bank of the Congo seems almost uninhabited. The journey from Leopoldville to Bolobo was accomplished in four days, traveling ten hours a day. The mouth of the Bochini is in lat. 3° 12′, and is almost closed up by rocks, which obstruct the first thirty miles of the channel. The Ba-buma of this river are regarded by our travelers as the best examples of the African they have met with. They are well-formed, intelligent, friendly, industrious, and seem to lead a happy domestic life. Their chief is a woman, Nga-Nkabe. Tall and stalwart, with a dignified air and queenly pose, Nga-Nkabe evidently knows how to rule. The Qwango comes in from S.S.E. with a depth of two fathoms, a width of 400 or 500 yards and a current of a mile and a half an hour. The houses upon its banks were round, like those seen by

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Capello and Ivens 200 miles further south, instead of square like those on the Congo. Women wear a solid brass collar weighing twenty-five to thirty pounds. Our travelers arrived at Bolobo during the saturnalia consequent upon a chief's death, and state their impression that the main characteristics of the people are drunkenness, immorality and cruelty in the most revolting excess. ——Mr. H. E. O'Neill draws attention (Proc. Roy. Geog. Soc., 1885, p. 373) to the neglected port of Nakala, in Fernao Veloso bay, north of Mozambique. It has numerous good anchorages, and offers magnificent conditions for the founding of a colony. Nakala is a deep inlet forming a southern prolongation of Fernao Veloso bay.——Dr. H. Zoller, in his account of Togo land, published in the *Kolnische Zeitung*, states that the streets of the Togo villages are better swept than those of Berlin. Refuse is thrown into large holes, which are covered over when full. The rectangular houses are built of huge bricks made of clay, reeds and straw, the roof is thatched with straw, and the floor is covered with red clay. Sometimes there are two or more apartments, provided with windows having wooden shutters, and occasionally there is an upper floor with a kind of staircase.——The expedition of Messrs. F. L. and W. D. James has returned to England. The Messrs. James intended to cross from Berbera to Magadoxo, but though accompanied by sixty Somali and with Dualla, one of Stanley's best men, for headman, they only succeeded in reaching Barri, on the Webbe river. The greater part of this journey of about 400 miles, was over territory before unvisited by Europeans. Barri is 215 miles from Magadoxo.——Since the departure of Mr. Comber, his colleague, the Rev. G. Grenfell, has ascended the Mabangi, or Ubangi tributary to 4° 30′ N. lat., the Alkere to 2° 50′ N., the Lubilash, or Lomame, to 1° 50′ N., the Mbura to cataracts ten miles from its mouth and the Kelemba, or Ruki, as far as it was navigable, viz., 100 miles. The Sankuru proved an unimportant small stream; the Albangi is *the* river, but the tribes are bad and fierce; and the Ukere is thought to be the Welle (Proc. Roy. Zoöl. Soc., June).——Mr. E. H. Richards, an American missionary, has journeyed from Inhambane to the Limpopo, through a region which is at present a blank on our maps. The Bombom river forms the western boundary of the Portuguese province, and drains a large area of Western Inhambane, as well as the eastern slope of the Makwakwa ridge to the west. The country west of this ridge is semi-deserted in consequence of the raids of Umzila's soldiers. From the Makwakwa ridge to the Limpopo is level land. The Ama-gwaza, or people of Umzila, inhabit or control the country from the Zambesi to the Limpopo, and with the exception of the Portuguese possessions of Chiluan and Inhambane, from the sea in the east to the Matabele country on the west.——It is announced from Lisbon that the Portuguese explorers, Capello and Ivens, have dis-

covered the sources of the Lualaba, Luapula and Chambese, the head waters of the Congo.

ASIA.—*Asiatic News.*—Col. Prejevalsky has discovered three peaks, each over 20,000 feet high, in the middle range of the Kuen-lun. The plateau skirting the middle Kuen-lun has an average height of 4000 feet.——Dr. Gottsche, who has recently returned to Europe after a journey of over 2000 miles in Korea, believes that the population is much underrated. He has visited all the eight provinces and eighty-four out of the 350 districts, and has, through influential support which he received, been enabled to collect much statistical information which is wholly new. He states that the official census only takes into account the adults, and that therefore its nine millions must be increased to over twelve. The geology of Korea seems to be that of the bordering Manchuria. He found few traces of that early development of art and science which made Korea the instructress of Japan.——The labors of Dr. A. Grünwedel and Dr. R. Virchow upon the material brought to Europe by Dr. Riebeck from among the Chittagong Hill tribes, result in emphasizing the already established distinction between the Khyonng-tha, or river tribes, and the Tonng-tha, or hill tribes. The latter (Pankhos, Banjogis, Mros, Kumis, etc.) are darker than the former, and seem to approach nearer the Kolarian aborigines of India. The former (Maghs, Chakmas, Tounjinyas, etc.) have become intermingled with Bengalese and other intruders, and have a yellow complexion. Dr. Virchow is careful to point out that none of these hill tribes lend any support to the theory of an aboriginal Negrito population formerly spread over the whole of India and Indo-China. —— Iturup and Kunashiri, the most southern of the Kuriles, are also the largest. Iturup, according to a recent number of the *Japan Gazette*, is 113 miles long and seventy-seven in greatest width; Kunashiri is sixty-two miles by seventeen. All the Kuriles are very desolate, and only sparsely occupied in summer by Japanese and Ainos, who come to fish. In Iturup there is an impassable jungle of bamboo grass between the coast and the mountains. Professor Milne thinks it not unlikely that the Iturup bear, which seems to resemble the grizzly, may be new to science.——Information has been received at the Hague from Java that the state of Krakatoa was causing some anxiety. Subterranean sounds have been heard, and the rocks which emerged from the sea during the last eruption suddenly disappeared at the end of April.

AMERICA.—*American News.*—Asaph Hall writes to *Science* to contradict the Encyclopædia Brittanica, Appleton's American Cyclopædia and Johnson's Cyclopædia with regard to the height of land in Connecticut. Against the statement of the Ency. Britt. that Connecticut has no land " above a thousand feet in ele-

vation," he gives the following table, based on a survey of the Connecticut Western railroad, made in 1873 by Mr. E. N. Bradford :

Joy mount (Goshen)	1642 feet.
Haystack mount (Norfolk)	1672 "
Bald mount (Norfolk)	1770 "
Bradford mount (Canaan)	1910 "
Bear mount (Salisbury)	2100 "
Brace mount (Salisbury)	2300 "

——F. Gardiner, Jr., in a communication to *Science*, describes a natural bridge sixty-five feet long, fifteen feet wide where narrowest and two feet thick in the center, situated in a small cañon at a distance of about twenty miles from the Atlantic and Pacific railroad, near the boundary of Arizona and New Mexico.—— Lieut. Hohm, of the Danish Greenland exploring expedition, separated from Dr. Eberlin at Tingmiarmint (62° 40′ N. lat.) with the intention of reaching Angmaksalik, in 65° N. lat., where there is a fixed settlement not hitherto visited by Europeans. The heathen East Greenlanders are as tall as the peoples of North Europe, and mostly have dark eyes and hair. They seem to have nothing in common with the Eskimo, yet their utter absence of Norse tradition and total want of civilization, is thought to preclude the possibility that they are descendants of the Norsemen.

GEOLOGY AND PALÆONTOLOGY.

THE RELATIONS OF THE PUERCO AND LARAMIE DEPOSITS.—Some writers having suspected the identity of the formations above named, and the consequence which follows, that the Puerco mammalian fauna was contemporary with the dinosaurian fauna of the Laramie age, the following observations on their stratigraphic relations are now given. They are derived from the notes of several years' residence and exploration by my correspondent, David Baldwin, which connect those made by myself in New Mexico in 1874, published in the Wheeler Survey Report, with those made by Holmes and Endlich in 1878 in Colorado, and published in the Hayden Survey Report.

At the locality where best developed, the Puerco beds have a thickness of about 850 feet, and contain Mammalia to the base (see NATURALIST for April and May, 1885). The Laramie beds succeed downwards, conformably it is thought by Mr. Baldwin; and have a thickness of 2000 feet at Animas City, New Mexico. They rest on Fox Hills marine Cretaceous of less thickness. A few fossils sent from time to time by Mr. Baldwin identify the Laramie. This is especially done by the teeth of the dinosaurian genus Dysganus Cope,[1] which is restricted to the Laramie

[1] Proceedings Academy Philada., Oct., 1876.

formation everywhere. Also by the presence of the genera Læ-laps and Diclonius, which in like manner do not extend upwards into the Puerco beds. The Lælaps is principally represented by teeth, which resemble those of the *L. incrassatus* Cope more than those of any other species, although these parts are not alone sufficient for the determination of species in this genus. The Dysganus agrees with the *D. encaustus* Cope, which, with the *Læ-laps incrassatus*, was described from specimens from the Upper Missouri. A species of Trionyx and a large crocodile accom-pany these species. The latter differs in the character of its teeth from any species known to me. The crown is compressed at the apex, and there are two well-marked cutting edges, which slope in such a way as to divide equal faces unsymmetrically, *i. e.*, the greatest convexity of one not being opposite to that of the other; the transverse section resulting being an oblique oval, or at the base a regular oval, with cutting edges at points diagonal to each other. On one side of the tooth thus divided, the surface is grooved by twenty-five strong sulci, which become very fine at the obtuse apex of the tooth. The opposite (external ?) side of the crown is smooth, excepting traces of sulci and silky grooving towards and at the apex. Diameter of crown where broken off, anteroposterior, M. .0125; transverse, .009. No species of this character has come under my observation from the Laramie or any of the Tertiary formations. I name the species *Crocodilus stavelianus*, after Mr. J. Thomas Stavely, one of the enterprising publishers of the AMERICAN NATURALIST.

It is thus evident that the Puerco formation is quite distinct from the Laramie, although it is possible that it may be proper to associate it with the Laramie in the Postcretaceous series.[1] When the Cretaceous mammalian fauna comes to be known, it will be very apt to agree with the Puerco in its leading features. These are, the absence of Perissodactyla and of Rodentia, and of course of mammalian orders not found below the Miocenes; and in the constitution of the mammalian fauna by Condylarthra, Bunothe-ria and Marsupialia exclusively. The Postcretaceous series as a whole may be ultimately distinguished from the tertiary by these peculiarities, together with the presence of the reptilian genus Champsosaurus.—*E. D. Cope.*

CROSBY'S CONTINENTS AND OCEAN BASINS.—W. O. Crosby (Proc. Bost. Soc. Nat. Hist.) discusses the origin and relations of conti-nents and ocean basins. Reviewing the hypotheses of Thomson, Dana, Le Conte and others, he arrives at the conclusion that existing facts necessitate the existence of a plastic zone beneath the solid crust, this zone occupying the stratum at which temper-ature is highest in proportion to pressure. As the infiltration of

[1] This has been done in the table of formations in Vol. III U. S. Geol. Survey, F. V. Hayden, Tertiary Vertebrata, p. 42.

water increases the tendency to fusion, it is probable that this plastic zone commences at a depth of about forty miles. The interior of the earth may have a rigidity exceeding that of steel, but even if, according to the ideas of Wadsworth and some others, the interior is liquid, this does not affect the action of the surface zone of liquid matter upon the solid crust above it. The two opposing theories of continent formation are thus stated: (1) Continents and ocean basins are upward and downward bendings of the earth's crust; (2) the continents and ocean basins are due to the greater conductivity and more rapid cooling of the continental portions of the earth's crust, hence they are permanent, and the continents are wider and the seas deeper now than at any former period. The hypothesis of the earth's unlike composition along different radii is necessary to the second theory, and is here stated to be unsupported by evidence. According to the former theory the grand distortion which the crust experiences before the strain becomes great enough to crush it, accounts for the continents, while the ultimate crushing produced the mountains.

Mr. Crosby does not, therefore, believe in the permanency of continents, which is held by many geologists as an article of faith. We have, he argues, certain knowledge of a Palæozoic subsidence of 40,000 feet in the Alleghanies, a Mesozoic subsidence of 50,000 feet in Central Europe, and, according to King, a subsidence of 60,000 feet in the Rocky mountains. With these facts in mind how can it be held that any part of the floor of the deep sea ever has been or will be elevated to form dry land?

GEOLOGICAL NEWS.—*General.*—All the geological formations are met with in Japan, but the Palæozoic formations embrace the largest extent of territory. The Trias occurs in the north and south-west of the main island and in Shikoku. Chalk is also widely distributed in Niphon, Yezo and Shikoku. The Cenozoic occurs everywhere on the edges of the older mountain ranges. Basalt is rare, the volcanic rocks are mostly trachyte and andesite, and granite covers an area only second to that occupied by the Palæozoic formations. Volcanic tuff, consisting principally of decomposed silicates, is among the soils of Japan, and forms most of the uncultivated plains at the foot of the mountains. The geological and topographical survey of Japan has worked over an area of about eighty geographical miles square.

Palæozoic.—Mr. O. A. Derby states (Geog. Physica do Brazil, Vol. 1) that the Brazilian tablelands are composed of horizontal or nearly horizontal beds. The basis of the plateau consists of ancient metamorphic rocks; these form nearly the whole of the mountain and mountainous tablelands, and appear whenever later rocks have been denuded. They thus occur at the bottom of nearly all river valleys. The older of these rocks are highly crystalline, the newer less crystalline. The granites, syenite,

gneiss, etc., of the first series is supposed to be Laurentian, while the quartzite schists and limestones, etc., of the second series are Huronian. The latter series is the great mineral repository of Brazil. Here occurs the schistose micaceous quartzite called itacolumite, itabirite, in which the mica is replaced by micaceous iron and extensive beds of hematite and other iron ores, and gold. Tapanhoacanga, consisting of masses of iron ore cemented by limonite, is often very rich in gold. The Serra do Espinhaço is capped with sandstone believed to be Silurian, and probably a part of the sandstones of the Sao Francisco-Tocantins divide are also Silurian. The tablelands of the Parana basin, composed of sandstone and shale with some limestone, are probably Devonian and Carboniferous. Devonian fossils characterize an extensive area in the Campos Geraes de Parana, while the Carboniferous covers a large region farther to the westward in the same province, and in Sta Catherina, Rio Grande do Sul and Southern and Western Sao Paulo. Coal has been found at various points. Immense dykes of diorite traverse these two formations, and by their decomposition afford a dark red soil called *terra roxa*.——O. A. Derby (*Am. Jour. of Science*, Sept., 1884) shows that the flexibility of itacolumite is only a surface quality. In a cutting upon the Rio and Minas railroad (Brazil) a thickness of forty meters of itacolumite is laid bare. The upper portion consists of massive beds from one to three meters thick, in which flexible portions are rarely found. In the lower part the beds readily divide into thin laminæ, most of which are more or less flexible. Exposures of unweathered itacolumite are rare, and from the study of this Mr. Derby concludes that flexibility is not an original characteristic of the rock but a phase of weathering brought about by percolating waters.

Silurian.—Sr. Leoǹ Tourquist has published descriptions of 113 species and varieties of trilobites discovered in the Silurian basin of Siljan, in Dalecarlia. The descriptions mainly rest on detached heads and pygidia, as the fossils are fragmentary.

Carboniferous.—S. H. Scudder has described two new Carboniferous insects from England. One of these can with certainty be referred to Brongniart's group of Protophasmida. The wing is broadest in the middle, and from the appearance of the fragment, which is 75^{mm} long, must have had a length of 130^{mm}, so that the living insect probably possessed an expanse of wing of at least ten inches.

Cambrian.—Mr. W. O. Crosby (Proc. Bos. Soc. Nat. Hist.) defends his previous conclusions respecting the relations of the conglomerate and slate in the Boston basin. He maintains that the conglomerate underlies the slate, that there is essentially but one formation of conglomerate and one of slate; that both are Primordial, or at least Cambrian, and that the Boston basin con-

tains no Carboniferous beds. He declares that the Carboniferous shales and sandstones are quite distinct lithologically from the slates of the Boston basin, which latter, as well as the conglomerate, are traversed in all directions by numerous and large dykes of trap or diabase, while no eruptive rocks have ever been discovered in the adjacent Carboniferous. The rocks are decidedly homogeneous, passing gradually into each other, and have also a general agreement in strike and dip. The conglomerate underlies the slate, not because it is older than the slate, but because it was deposited in shallow water, the slate in deeper, and the latter deposit commenced before the first was completed. In not a few instances the conglomerate can be seen to pass beneath the slate.

Jurassic.—A specimen found in the Waldean of Hastings (Eng.) throws some light on the structure of the sternum in Iguanidæ. It consists of an azygos bar, from near one end of which diverge two smaller rods which terminate mesially in expanded ends. Professor I. W. Hulke regards the diverging rods as clavicles, and the azygos bar as the interclavicle, and suggests that the costal sternum may have been cartilaginous.

Cretaceous.—M. Ch. Arnat (Rev. Scientifique) describes the geological structure of the Saharan district of M'zab. This principally consists of an elevated plateau (*hamada*) of Cretaceous rocks, rising toward the north-east into a cliff facing the basin of the Oued Loua, while toward the south-east it is lost beneath the alluvium of the Oued Rhir. Thus this rocky plateau, which is entirely desolate and without running water, is bounded east and west by alluvial deposits. Calcareous concretions mark the passage between the two formations. The few fossils indicate that the strata must be placed between the Gault and the white chalk (Turonian and Cenomanian). The calcareous crust forming the soil of the plateau is Taranian, while the escarpments formed by the marls, as well as the marly limestones, are Cenomanian.—— Professor Lundgren, in his monograph of the Swedish Cretaceous Brachiopoda, states that the Cretaceous strata which occupy an extensive area in the province of Skeine, at the southern extremity of the country, have peculiar petrographic and palæontological characteristics in the three districts of Kristianstad, Ystad and Malmö. Those of Kristianstad are chiefly *gruskalk* (a limestone composed of the fine débris of shells of mollusks and echinoderms) with a mixture of quartz sand-grains and occasionally metamorphic boulders. In Ystad the prevailing rocks of the Cretaceous strata are incoherent calcareous sandstones, with a variable quantity of green grains; while in Malmö the beds are pure white chalk of various degrees of hardness, with abundant layers and nodules of flint. These Malmö beds are an easterly continuation of those of Denmark, and closely resemble those of

Norwich (Eng.). In Malmö the upper chalk is overlaid by the Danien, or newer chalk, which is without belemnites or Belemnitella. From the upper chalk the only new species described is a Lingula, but from other horizons there are sixteen new forms. The most prolific brachiopod fauna is the lower division of the Kristianstad district, characterized by *Actinocamax ventricosus.*

Tertiary.—Ernst Hoken has endeavored to ascertain the groups of fishes to which belong the otoliths, which are the most common remains of bony fishes in the Oligocene of North Germany. He finds the Gadidæ predominate, but identifies also species of Percidæ, Sciænidæ, Sparidæ, Triglidæ and Pleuronectidæ.——Although Professor Marsh's book on the Dinocerata bears date 1884, the first copy was received from the binders towards the end of February, 1885.——Mr. J. S. Gardner, in a lecture upon the Age of the Basalts of the North-east Atlantic, states that the determination of the Antrim basalts as Miocene is not satisfactory; and that the assumption that all floras comprising modern and temperate-looking genera (such as willow, beech, alder, hazel, poplar, elm, pine, liquidambar) must be Miocene, while a flora of palms, Proteaceæ, figs, Aralias, etc; must be Eocene, is erroneous. The whole of the American flora with Dicotyledons would have been absorbed into the Miocene had it not been for stratigraphical evidence. The so-called Miocene plants of Greenland are, by Mr. Gardner, referred to the middle Eocene, and the unfossiliferous beds below their horizon to the base of the Eocene. The basalts in Ireland restore the upper chalk. In conclusion Mr. Gardner said—"I think we may assume that the old land on which this flora (that of the middle series of the Irish basalts) grew formed a part of the continent of Europasia, in Eocene times, and further that it formed or was not distant from its western coast line." Mr. Gardner believes that the silicified wood and lignites of Lough Neagh, may be derived from the basalts. The prevailing conifers of these Eocene basalts are a cypress, a cryptomeria and a pine.

Post-Glacial.—W. O. Crosby (Proc. Bost. Soc. Nat. Hist.) gives what seems a very probable explanation of the gorge called Purgatory, at Sutton, Mass. The chasm is about 50 feet wide, with vertical walls, and pierces the micaceous gneiss of the region. He suggests that during some disturbance of the earth's crust, the wedge-shaped mass of rock between two master joints has dropped. This idea is in accord with facts. The chasm is parallel to a well-defined system of joints, and its walls are evidently joint-places. There are no evidences of marine erosion to support Dr. Hitchcock's theory. The date of this chasm must be post-glacial, as, if it lay in the path of the ice-sheet, it would have been filled with glacial detritus. The explanation will of course apply to some other similar gorges.

Quaternary.—Prof. A. Nehring (Sitz. Ges. naturf. Freunde, Berlin) asserts that the horse existed in Europe during the

diluvial age. At that time middle Europe was a land of steppes, and a strong-kneed, thick headed, medium-sized wild horse existed there. Later on the steppe became covered with forest, the moist climate of which was unfavorable to the horse, which became confined to the pasture grounds and thus fell more and more under the influence of domestication, whilst it degenerated into the small weak-kneed horse found in the moors of Northern Germany, in some pile-dwellings, and in the "Kreisgruben" of Oldenburg. The descendants of this European horse can still be traced in some breeds. This view does not shut out the idea that the introduction of the Asiatic horse may have contributed to the change of type.

Recent.—Dr. R. v. Lendenfeld has found undoubted traces of glaciation throughout an area of 100 sq. miles upon the highest part of the Australian Alps, at elevations of above 5800 feet. The rocks showing traces of ice-action are all granite.

MINERALOGY AND PETROGRAPHY.[1]

TESCHNITE.—Dr. Carl Rohrbach[2] has made a thorough reëxamination of all the occurrences of teschnite of which he could obtain specimens, and concludes that this rock is not entitled to the position to which it was assigned by Rosenbusch in his system of rock classification published in 1877.

The paper opens with a valuable review of the literature of this much discussed rock-type. The best known localities are those in the neighborhood of Teschen, in Moravia, where the rock, as early as 1821, was described as a diorite. This determination appears to have been regarded as satisfactory until Hohenegger threw doubt on it, and in 1861 proposed to call this in many respects peculiar group of rocks "teschnite." This name was accepted by Tschermak, in 1866, for the lighter colored varieties, while he designated the darker ones as picrite. Zirkel, in 1868, and Tschermak, in 1869, first mentioned nepheline as a constituent of these rocks. In 1877 Rosenbusch published the results of his examination of these rocks, which he defined as pre-Tertiary plagioclase-nepheline aggregates, and as such assigned them a very important place in his classification. Other masses of a similar age and mineralogical composition have been described by Tschermak from the Caucasus, and by McPherson in Portugal. Analcite, supposed to be an alteration of the nepheline, is a common constituent at all of these localities.

As the principal primary constituents Dr. Rohrbach designates plagioclase, augite, hornblende, biotite, olivine, magnetite and apatite. The augite is called "automorphous" when it is present

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins Univ., Baltimore, Md.

[2] Ueber die Eruptivgesteine im Gebiet der schlesisch-mährischen Kreideformation. Tschermak's Min. u. Petr. Mitth., VII, pp. 1–63.

in well defined crystals, and "xenomorphous" when it merely fills the spaces left between the plagioclase crystals, as is common in rocks of the diabase type. A compact brown hornblende is a common constituent and presents the most interesting relations to the augite. These are described at length and admirably illustrated in a colored plate. This hornblende which very frequently makes up the outer portion of a pyroxene crystal, is regarded as in no way of secondary origin, but as an original crystallization due either to changes in chemical composition or physical conditions in the magma. The following analyses of the two minerals illustrate instructive chemical differences:

	Augite.	*Hornblende.*
SiO_2	44.22	36.91
Al_2O_3	10.49	16.30
Fe_2O_3	11.98	5.28
FeO	5.77	12.27
MgO	7.02	8.83
CaO	22.54	16.91
	102.02	96.50

The hornblende contains 3.5 per cent of alkalies.

The nepheline Dr. Rohrbach was unable to discover in any specimens of teschnite from either Moravia, Caucasus or Portugal. He thinks that what has thus far been considered to belong to this species is in reality apatite, and would hence strike teschnite from its place in Rosenbusch's system.

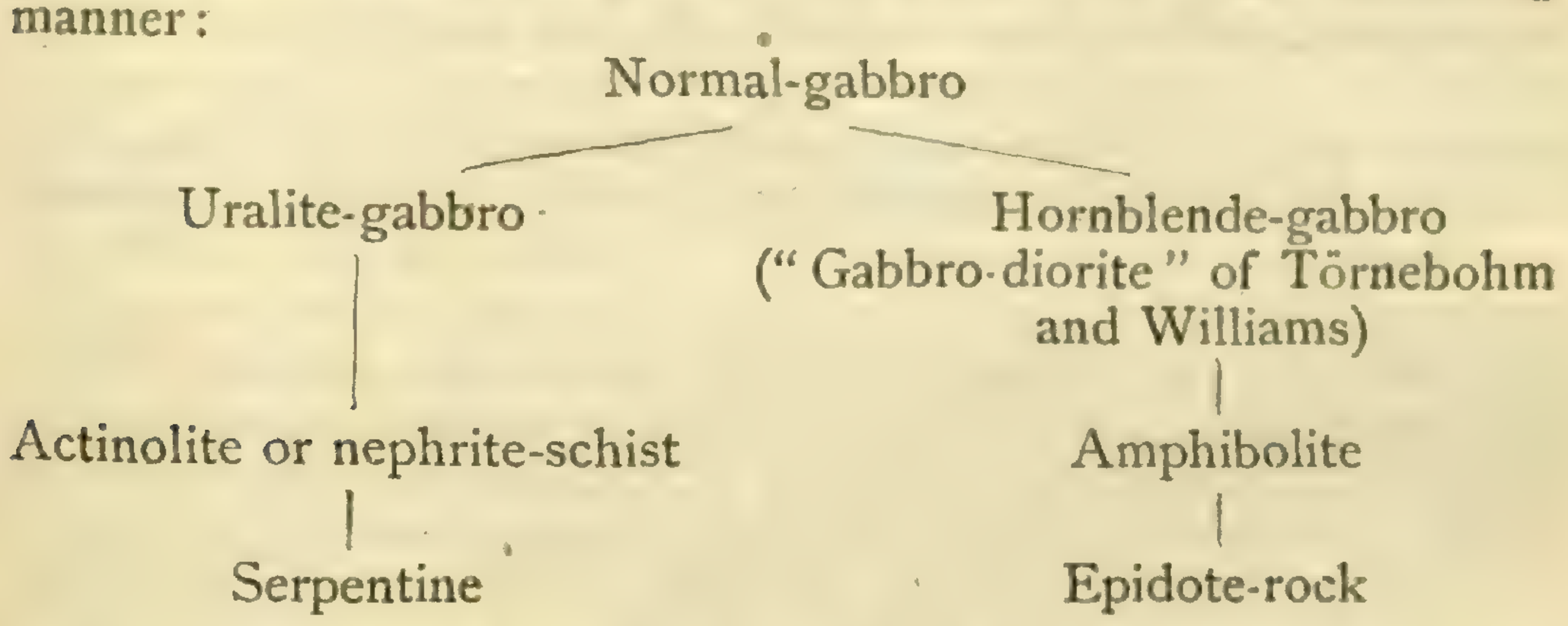
[Even in case Dr. Rohrbach's results regarding the presence of nepheline in the specimens examined by him are entirely correct, no account has been taken of the dykes of ancient plagioclase rocks occurring in the Silurian limestone near Montreal, in Canada, which, according to Drs. Hawes and Harrington, are undoubtedly rich in nepheline. This mineral is often present in large sharply-defined hexagonal crystals closely resembling those so characteristic of the Katzenbuckel "nephelinite."—*G. H. W.*].

METAMORPHOSIS OF GABBRO.—The widespread origin of hornblendic schists by the uralitic alteration of massive pyroxene rocks receives additional evidence in its favor wherever the attention of geologists is especially directed to it. The observations of Lehmann in Saxony, Reusch in Norway, Phillips in England, Becke in Austria, Streng and Irving in the region about Lake Superior in the U. S., all indicate the great geological importance of molecular changes in producing amphibole schists from pyroxene eruptive rocks. The studies of Kloos[1] in the Black Forest point to a like relation between the gabbros and diorites of Ehrsberg. Mr. Frederick H. Hatch, of London, has contributed a similar investigation of the gabbro occurring at Wildschönan in the

[1] Neues Jahrbuch für Min., etc., III, Beil. Bd.

Tyrol, and of the associated hornblende schists, which he regards as having undoubtedly been derived by its uralitization.[1] Several wood-cuts illustrate the different stages of the alteration as it was observed under the microscope, The writer finds that the schistose structure is developed in the rock in proportion as the alteration of the pyroxene to hornblende has progressed, and is hence inclined to attribute both to the action of great pressure.

Two parallel series of alteration which have gone on in the gabbros of Wildschönau, the writer illustrates in the following manner:



PETROGRAPHICAL NEWS.—Barrois[2] and Des Cloizeaux[3] have recently made important contributions to our knowledge of the physical characteristics of the minerals of the chloritoid group, which are becoming more and more generally recognized as widely distributed rock constituents. Van Werveke[4] publishes the results of a new microscopical study of a large amount of petrographical material in which this class of minerals plays an important rôle. This consists of the ottrelite schists occurring near Ottré and Viel-Salm in the Ardennes. These he divides into ottrelite-phyllite proper, garnetiferous ottrelite-phyllite, magnetiferous ottrelite-phyllite and ottrelite-bearing quartz-breccia. —— Professor E. Cohen, formerly of Strassburg, who has recently been called to the University of Greifswald, has a letter in the Neues Jahrbuch für Mineralogie,[5] in which he revises the determination of the diallage in the Schriesheim picrite, made by him some twelve years ago. The resemblance of this rock to certain olivine rocks occurring near Peekskill, on the Hudson river, is very striking. In them large bronze-like cleavage surfaces of hornblende are mottled with much smaller grains of olivine and pyroxene. An almost identical mineral occurs in the Schreisheim rock, which was formerly considered by Cohen as diallage, but which now,

[1] Ueber den Gabbro aus der Wildschönau in Tirol und die aus ihm hervorgehenden schiefrigen Gesteine. Tschermak's Min. und Petrog. Mitth., VII, 1885, pp. 75–87.

[2] Bull. soc. min. de France, VII, p. 37, 1884.

[3] Bull. soc. min. de France, VII, p. 80, 1884.

[4] Neues Jahrbuch für Min., etc., 1885, I, pp. 227–235.

[5] 1885, I, p. 242.

upon reëxamination, proves to be also hornblende. The writer proposes to call this type of rock, composed essentially of olivine and hornblende, "hudsonite," on account of its being so well developed at Stony point, on the Hudson river. [The name "hudsonite" was applied, as early as 1842, by Beck to a variety of augite occurring near Cornwall, on the Hudson river. It would therefore seem preferable, if a new name is considered necessary, to employ some other than that proposed by Cohen. The present writer has elsewhere suggested "cortlandtite" as appropriate, since this rock is such a typical member of Professor Dana's "Cortlandt Series."—*G. H. W.*]——Dr. K. Oebbeke,[1] of Munich, communicates some observations made by him on a specimen of andesite from the summit of Mt. Tacoma, Washington Territory. The question of the existence of pleochroic augite is again discussed and regarded as undecided in spite of the work of Cross, Hague and Iddings on the western hypersthene-andesites. If the matter is still in doubt it must be confessed that Oebbeke here furnishes but little convincing evidence in favor of a pleochroic monoclinic pyroxene.——R. D. M. Verbeek[2] makes some interesting remarks on the recent lavas of the East Indian archipelago. These are, for the most part, hypersthene-andesites, or, as this writer prefers to call them on account of the presence of both hypersthene and augite, "pyroxene-andesites." The hypersthene is almost always in excess of the augite. Pure augite andesites have not been observed, but such as contain only hypersthene rarely occur. The complementary rôles played by the hypersthene and olivine in these rocks was noticed by Verbeek independently of Hague and Iddings, who discovered and described the same in their notes on the hypersthene andesite and basalt of the Western U. S. in 1883.——Mr. G. P. Merrill,[3] of the U. S. National Museum, has published some notes on the hornblende andesite from the new volcano on Bogosloff island, in Behring sea. They are quite normal in appearance, containing lath-shaped plagioclase crystals, brown hornblende and green augite imbedded in a microlitic base. Two varieties are distinguished, one light colored with fifty-six per cent of silica and the other much darker with fifty-one and a half per cent.

BOTANY.[4]

Botanical Work of the American Association for the Advancement of Science.—The Ann Arbor meeting of the association, just closed, proved of more than usual interest to the botanists. There was a notable increase in the permanent value of the papers. They were much more thoughtful, as a rule, than

[1] Neues Jahrbuch für Min., etc., 1885, I, p. 222.
[2] Neues Jahrbuch für Min., etc., 1885, I, p. 243.
[3] Proceedings of the U. S. National Museum, Vol. VIII, 1885, p. 31.
[4] Edited by Professor Charles E. Bessey, Lincoln, Nebraska.

those presented at previous meetings, and came up more nearly to the standard demanded by the science of to-day. Below we give brief abstracts, which will show the general nature of the papers.

"An observation on the hybridization and cross-breeding of plants," by E. Lewis Sturtevant. This gave in detail the observations on crossed beans, maize, barley, peppers, tomatoes, lettuce and peas, made at the New York Agricultural Experiment Station. As a result of the observations the author concludes that in our domesticated vegetable plants cross-fertilization shows its effects at once in the reproduction of the form-species and varieties which are involved in the parentage of the crossed seed, or, in other words, the effect is *atavism* rather than a blending of properties.

"Germination studies," by the same author, gave the results of making numerous duplicate germinations, showing that different percentage-results are obtained as the quantity of seeds used is large or small. The influence of various temperatures was also discussed. These two papers will appear in the NATURALIST.

"The question of bisexuality in the pond-scums," by Charles E. Bessey. It has been held by some botanists that the pond-scums (Zygnemaceæ) show a distinct bisexuality, one of the filaments being male, the other female. Certain facts were presented which render such a view untenable. In many plants the cells of the same filament fertilize one another, as is notably the case in the forms which have been described as Rhynchonema. Several cases of hybridization were cited in which two filaments, both of which bore resting-spores, united with one another and produced a hybrid spore. The conclusion was that the pond-scums are not bisexual, but rather unisexual, that is, that while sexuality undoubtedly exists, there is as yet no differentiation into the proper male and female. Accordingly these plants must take a position just above the asexual prototypes, but below the clearly bisexual oöphytes.

"The process of fertilization in *Campanula americana*," by Charles R. Barnes. This species is strongly proterandrous. The pollen is scraped out of the anthers by the hairy style and brushed off before the stigmas open, thus securing cross-fertilization. The development of the pollen is normal. The stigmas are held together till mature by interlocking papillæ. The hairs on the style become partially introverted, thus freeing the pollen.

The pollen spore contains two nuclei, the larger of which, the vegetative, becomes disorganized shortly after entering the pollen tube, while the smaller spindle-shaped generative nucleus persists.

The embryo-sac is cylindrical, with a gradual enlargement near the micropylar end, where is located the egg-apparatus, and an abrupt enlargement at the chalazal end, in which lie the antipodal cells. There are usually two sac-nuclei.

The pollen-tubes enter the style *between* the bases of the papillæ of the stigma, pass down in the strands of conducting tissue, and *not* through the central canal, around which this tissue is arranged. The paper was followed by an account of the methods used, and illustrated by figures drawn upon a large chart.

"Proof that Bacteria are the direct cause of the disease in trees known as pear-blight," by J. C. Arthur. Cultures of the bacterium taken from blighted twigs were made in sterilized corn-meal juice. After a few days some of the bacteria, which had increased rapidly in this medium, were transferred (a drop only) to another sterilized preparation of corn-meal juice. After a few days another transfer was made, and this was continued until the sixth culture had been reached, when there was presumably but an infinitesimal amount of the original diseased juice present. Inoculations made with the bacteria of the last culture resulted in producing the blight as certainly and rapidly as in the first case.

The crucial experiment was made by filtering a watery solution containing the bacteria, and then inoculating with the bacteria on the one hand and the filtration on the other, resulting in blight in the former and none at all in the latter case.

"The mechanical injury to trees by cold," by T. J. Burrill. There are two kinds of mechanical injury due to a low temperature, viz: (1) The cracking and splitting of the bark and wood in a longitudinal-radial direction; and (2) the separation of the concentric layers of wood and bark, and especially the rupture of the cambium, thus destroying the bark and perhaps also killing the tree.

The first injury is due to the shrinking of the tissues by cold. The second is due to the growth of ice-crystals in the annual rings or on the surface of the wood.

"Further observations on the adventitious inflorescence of *Cuscuta glomerata*," by Charles E. Bessey. A further examination shows that it is the universal rule in this species for the inflorescence to develop from lateral adventitious buds, and that no normal inflorescence is developed. The adventitious inflorescence always bears a definite relation to the parasitic roots; that portion of the stem which bears roots produces adventitious inflorescence, and the greater the number of roots the greater the mass of inflorescence. No adventitious inflorescence is produced upon any portion of the stem which does not bear roots.

The stem proper (main axis) all dies away very soon, not only between the inflorescences but in the masses of inflorescence also. The flowering stems soon establish direct structural relations with the root, and thus with the host plant. Of other species thus far examined, *Cuscuta arvensis* does not produce adventitious inflorescence, while *C. chlorocarpa* and *C. gronovii* produce an abundance of both the normal and the adventitious flower

clusters, and in both cases the flowers, fruits and seeds appear to be well developed.

"On the appearance of the relation of ovary and perianth in the development of dicotyledons," by John M. Coulter. An examination of many species of dicotyledons (belonging to the orders Ranunculaceæ, Leguminosæ, Rosaceæ, Saxifragaceæ, Onagraceæ, Rubiaceæ, Umbelliferæ, Compositæ, Borraginaceæ, Scrophulariaceæ and Labiatæ) shows that in every case the first character recognized in the development of the flower is that of inferior or superior ovary, and that a most simple grouping of the orders upon that basis is possible. Grouping the dicotyledons upon this basis results somewhat as follows: The Compositæ take place at the head of the list, then near them come the Umbelliferæ, Rubiaceæ, etc., etc. The intermediate orders which have inferior and superior ovaries, as the Rosaceæ and Saxifragaceæ, would occupy a proper intermediate position, and finally those with superior ovary or ovaries only, as the Scrophulariacæ, Labiatæ, Leguminosæ, etc., would be arrayed in a descending series.

"The development of the prothallium in ferns," by Douglass H. Campbell. The paper gave the details of many observations upon the development of the prothallia of ferns, accompanied by figures of the various stages.

"Notes upon some injurious Fungi of California," by William G. Farlow. The author observed *Peronospora hyoscyami* D.By. growing abundantly upon *Nicotiana glauca*, a shrubby plant, native of Buenos Ayres, which is now common in Northern Mexico and Southern California. As the shrub is a near relative of the cultivated tobacco, *Nicotiana tabacum*, there is danger that the parasite may be transferred from the former to the latter.

The hollyhocks of California are affected by a rust (Puccinia of some species) which was at first supposed to be identical with the hollyhock disease of Europe (*Puccinia malvacearum*). It is, however, entirely distinct, being the same species as that which occurs upon species of Malvastrum in some of the Western States. There is danger that this may become transferred to the cotton plant.

"A new chromogenous Bacillus," by D. E. Salmon and Thomas Smith. A Bacillus, named *B. luteus suis*, was found in the pericardial effusion of hogs affected with swine plague.

The Botanical Club of the A. A. A. S.—About seventy members of the association registered themselves as botanists at the Ann Arbor meeting. Every member of the club wore a yellow ribbon in addition to the regular association badge. Six sessions of the club were held in the university buildings, one of them occurring in the botanical laboratory.

During the first session a committee was appointed to take

into consideration the question of English names for the fungi and the diseases produced by them. The committee is composed of J. C. Arthur of Geneva, N. Y., Wm. G. Farlow, Cambridge, Mass., and Wm. Trelease of St. Louis, Mo., who are to act in conjunction with F. L. Scribner of Washington, D. C.

A committee was also appointed to take into consideration the relations of the botanists of the country to the National Herbarium at Washington. This committee, consisting of John M. Coulter of Crawfordsville, Ind., and Wm. J. Beal of Lansing, Mich., reported in favor of asking that the herbarium prepare a catalogue of its specimens and books so that the botanists may know what is to be found in it for consultation, and also in order that desiderata may be known to those who are able to supply them.

Professor Beal read a few notes upon laboratory methods. This was followed by discussion and a general interchange of notes.

Professor Halsted exhibited specimens of a wild grape from Iowa completely covered with *Peronospora viticola*. Near these specimens were many vines whose leaves were free from the parasite but whose *berries* were badly affected.

D. H. Campbell exhibited an organism from the Detroit river which he thought to be an alga. Other members doubted its vegetable nature. It was referred for further examination and study.

Professor Coulter presented a list, with comments, of the plants collected by the Greeley expedition.

Professor Barnes described the peculiar dehiscence of the fruit of *Campanula americana*, in which a peculiar little flap opens and lets the seeds out when the weather is dry, but closes when it is wet.

Professor Lazenby presented an additional list of plants new to the Ohio flora.

During the session in the botanical laboratory the whole time was given to the discussion of laboratory methods, and examination of various microscopes and of the laboratory books on the shelves in the room.

Professor Burrill called attention to the grape disease due to *Sphaceloma ampelina* D.By. Specimens were exhibited and passed around among the members of the club.

Mrs. Wolcott described an abnormal form of Campanula which had suddenly appeared in her garden, which provoked a discussion on weed seeds, in which it was suggested that many weeds survive in fields and meadows by the yearly growth of depauperate plants which, though small, produce perfect seeds.

Professor Barnes showed that the figures given in most books of the stomata of *Marchantia polymorpha* are erroneous in not

showing the guard cells, which lie at the bottom of the chimney-like structure.

F. L. Scribner gave some hints upon the making of drawings from botanical specimens.

Geo. U. Hays of St. Johns, N. B., sent a paper on the botanical features of New Brunswick, which was read by the secretary. The low temperature and damp air have affected the flora so that it is quite peculiar.

Professor Bessey described his herbarium cases which have doors which are readily removed entirely, and which he uses for tables by placing them upon trestles or flat backed chairs.

D. H. Campbell described the germination of Botrychium spores in so far as his observations had progressed. He succeeded in germinating the spores by constructing a box in such a way that the spores were under ground.

He also called attention to the crystals in the petiole of Onoclea.

J. C. Arthur exhibited specimens of Nepaul barley (*Hordeum trifurcatum*) in which the awns take a hood-like development, and in this hood additional flowers are found. The structure is very puzzling, as it appears that here a flowering glume (outer palet of the older books) bears flowers towards its upper extremity.

Dr. Walker, of New Orleans, mentioned a case of degeneracy of Indian corn. Kernels of Nebraska corn were planted in a pot in New Orleans, and produced perfect fruiting plants only fifteen inches in height.

The officers for the next meeting are John M. Coulter of Crawfordsville, Ind., chairman; J. C. Arthur of Geneva, N. Y., secretary.

The excursion on Monday afternoon to Tamarack swamp was very enjoyable, and to the younger botanists very profitable.

ENTOMOLOGY.

Dr. Brauer's Views on the Classification of Insects.—In a work entitled "Systematisch-zoologische Studien," extracted from the ninety-first volume of the Proceedings of the Academy of Sciences at Vienna, Prof. Brauer, after a long introduction on evolution, makes many valuable and suggestive remarks on the following subjects: The insect orders now existing did not originate from one another but from ancestors closely allied to one another; affinities of Eugereon; the forms of insects the earliest and last to appear in different formations; hypothetical ancestral forms; no primitive forms connecting the existing orders of insects yet found; necessity of the dismemberment of some existing orders which are now mingled together; how the orders should be characterized; thoughts on the origin of the winged insects; division of insects into originally wingless, and secondarily winged or wingless forms; relations of the mouth-parts in larvæ and imagines or

their different changes of form; necessity of the increase in the number of orders based on the structure of the mouth-parts; relations of the parts of the thorax; relation of the thorax to the hind-body (1. Value of the relations of the abdomen to the thorax and organs of locomotion. 2. Ancestral forms, retrograde developments); genealogy; deceptive similar adaptive forms of different orders give the delusive appearance of a common descent or of a union in a single order; basis of the establishment of a peculiar (eigenen) order; the nymph as the stopping place (anhaltspunkt) for genealogical researches; the larva and genealogy; homologies of the nymph stages; relation and similarities between the ametabolic and metabolic insects; registered or artificial orders; how valuable the secondary or primitive larval forms may be to the systematist; orthognath and hypognath larva and imago; what points are to be considered in the use of the larvæ in classification; systematic characters of the same; characters taken from the structure of the nervous system; relations of the young form to the grown-up animal within the limits of a single order which are important for the determination of the grades of development; Packard's superorders; position of the sixteen series of forms not connected by intermediate links; relation of the allied series in different directions; view of the groups considered as orders; supposed greater allied groups; and, finally, the characteristics of the subclasses and orders of insects.

Professor Brauer claims that exact researches on the existing insects lead to the establishment of sixteen groups, or orders, which are not connected by intermediate types. "The path to a common ancestral form is interrupted in many places. Moreover, fossil remains do not fill up the gaps." The fossils yet discovered show, he adds, that our so-called orders of insects have a high antiquity, for we find in the Paleozoic strata typical representatives, and indeed highly developed forms; he adds, emphatically, that there are no connecting types between the orders now in existence. He regards Dohrn's Eugereon as a synthetic type, but not Scudder's Atocina, Homothetidæ, Xenoneuridæ, Palæopterina, Hemeristina, or Goldenberg's Palæodictyoptera, which he considers as belonging to existing orders, remarking that "the collection of oldest known insects consists of genuine Orthoptera (Blattidæ, Phasmidæ, Mantidæ); of amphibiotic Orthoptera (Odonata and indeed, perhaps, Gomphidæ, which were related to Stenophlebia, in the Devonian), genuine Neuroptera (Sialidæ in the Devonian), and Rhynchota (Fulgoridæ), which differ only generically from the forms now living; or even, taking into account the more general generic characters, belonging to forms now living."

Brauer, after further suggestive remarks on the relations of the fossil insects to the existing orders, maintains that there are too

few orders of insects generally recognized. While 2300 species of mammals are distributed into sixteen orders, the more than 200,000 species of insects are placed in eight or nine orders. He also criticises the too brief descriptions of our orders of insects usually given. He divides the insects (Hexapoda) into two classes[1] *Apterygogenea* (Synaptera of Packard), which is opposed to all the other insects which he calls *Pterygogenea;* the latter class he divides into six superorders and the latter into sixteen orders, which are described at length.

The six superorders are as follows, beginning with the lowest:

1. Orthoptera (in the wider sense of authors and of Gerstaecker).
2. Thysanoptera.
3. Rhynchota.
4. Petanoptera (Neuroptera, Panorpatæ, Trichoptera, Lepidoptera, Diptera and Siphonaptera).
5. Coleoptera.
6. Hymenoptera.

The sixteen orders are as follows, beginning with the lowest:

1. Dermaptera.
2. Ephemeridæ.
3. Odonata.
4. Plecoptera (Perlariæ).
5. Orthoptera (Blattidæ, Mantidæ, Phasmidæ and Saltatoria).
6. Corrodentia (Mallophaga, Atropina, Psocidæ and Termitidæ).
7. Thysanoptera (Thripsidæ).
8. Rhynchota (Hemiptera).
9. Neuroptera sensu str. (Megaloptera and Sialidæ).
10. Panorpatæ.
11. Trichoptera.
12. Lepidoptera.
13. Diptera.
14. Siphonaptera (Aphaniptera).
15. Coleoptera.
16. Hymenoptera.

Space forbids any farther abstract of Brauer's important paper, or offering any criticisms. We are, however, by no means opposed to the dismemberment of the Pseudoneuroptera, and are inclined, with Brauer, to recognize the Panorpatæ as a group of equal importance with the Trichoptera. We are also impressed with the belief that the orders of insects are more numerous than usually accepted.—*A. S. Packard.*

Histology and Embryology of Insects.—The investigations of M. Weismann upon the changes which take place in the pupa state of insects are well known. M. Viallanes has followed in the same path, and a recent issue of the *Revue Scientifique* has

[1] Saussure's Hemimerus is regarded as unlike all other insects in possessing four and not three pairs of jaws, and "must form a new class."

given us a résumé of his memoir. He first studied the tissues of the larva and of the imago, and then followed out the mode of destruction of the larval tissues and the mode of genesis of those of the perfect insect. In his researches upon the nervous system of insects he found that besides the ganglionic chain and the stomato-gastric system, certain insects possessed nervous ganglia under the integuments, in some cases distributed without apparent order, but in others grouped symmetrically and connected with the principal centers. Another discovery was, that the sensitive nerves, when they arrive immediately below the hypoderm, enlarge into multipolar ganglionic cells, which anastomose in such a way as to form a rich subcutaneous plexus, the final branches of which end by free extremities under the hypodermic cells. Thus every part of the tegument has general sensibility. It has long been recognized that some of the hairs, or hollow conical outgrowths of the chitinous cuticle secreted by the hypoderm, were special organs of touch, and were accompanied by a nerve which formed a ganglionic bipolar enlargement. M. Viallanes has proved that the hair is secreted by a specially modified hypodermic cell, and that in the protoplasm of this cell the terminal prolongation of the bipolar nervous cell ends. The dorsal vessel of an insect is formed of a single layer of cells, but each cell is contractile through the presence in it of striated muscular microscopic fibrils. Each of these fibrils begins and ends in a small disc. A theory, generally admitted, holds that the active unity of a muscular fibril must be the space between two small discs, but this is the first verification of the theory.

The voluntary muscles of vertebrates exhibit little variety even in different zoölogical groups, and in any species have the same structure throughout. But in insects the motor muscles of the wings differ from those of the legs, and the contractile tissue of the larva from that of the adult. In the muscles of the wings of a fly the fibers (faisceaux) have no sarcolemma and only a few fibrils (colonnettes); in those of the wing of Dytiscus the fibers have no sarcolemma and only a single colonette or fibril, while in those of the legs the single fiber is enveloped in a sarcolemma. The ultimate elements, however, are the same in all. Previous histologists had proved that the motor nerves of the muscles of the legs of insects separate into their constituent fibrils immediately after penetrating the sarcolemma, but M. Viallanes shows that in insect muscles consisting of several fibers the nerve branches like a tree, as it does in vertebrates, while it separates at once into its constituent fibrils in muscles formed of but one fiber.

The second part of the memoir of M. Viallanes treats of the destruction of the larval tissues. M. Weismann had proved that the muscles, tracheæ, adipose bodies and peripheric nerves of the larva disappear entirely during the metamorphosis. M. Viallanes

finds that while some muscular fibers simply degenerate and are dissolved in the cavitary fluid, others change into cells which proliferate elements resembling the vitelline granules of birds and reptiles. These multiply exceedingly, the contractile substance disappears before them, and finally they disperse in the general cavity of the nymph. The tracheæ and salivary glands become filled with embryonic cells till the whole organ becomes embryonic, and its elements finally separate and disperse in the general cavity. The whole process is similar in its nature to the breaking down of vertebrate tissue in the morbid process known as inflammation.

The third part deals with the genesis of new tissues. It is singular that the integuments of the adult are not in any way derived from those of the larva. It was previously known that the larva contains within its body certain small white bodies disposed in pairs, and destined to form the head and thorax. The anterior pair are those of the head, while three superior and three inferior pairs in the following segments are those of the thorax, wings and legs. M. Viallanes has proved that the teguments of the abdomen are also formed from imaginal discs, but these abdominal discs are produced during the metamorphosis.

Each muscular fiber or bundle of fibrils is derived from numerous embryonic cells plunged in a homogeneous intercellular substance. The cells become the muscular nuclei, while the intercellular tissue becomes fibrillose and contractile.

The work ends in a detailed account of the development of the eyes. The eye of an insect consists of three regions: (1) The compound external facetted eye; (2) the ganglionic disc which forms a sort of screen between brain and eye; and (3) the optic ganglion which is the most external enlargement of the cerebral ganglion. M. Viallanes has traced the conducting nerve from an elementary eye or facet of the external eye, through the successive ganglia to the interior of the brain itself; and he shows that the germs of all the parts which enter into the visual apparatus exist in the young larva, enclosed within the brain, which they afterwards leave to take on their definitive form and occupy their destined position.

HORN ON THE ANISOTOMINI.—Dr. Horn remarks (Entomologica Americana, Vol. 1, No. 3, 1885): In the genus Scotocryptus the tarsi on all the feet are three-jointed. To this character Dr. Sharp attributes considerable value, and makes it the sole groundwork for the separation of a tribe which he places between the Anisotomini and Cholevini. From my own studies this numerical reduction of the several joints is only another step in the direction so plainly indicated in the genera already known. In order that the idea may be more readily grasped, the genera may

be disposed in the following order, the numbers referring to the tarsal joints:

Triarthron	5—5—5, ♂ ♀.	Amphicyllis	5—5—4, ♂.
Stereus	5—5—5, ♂ ♀.		5—4—4, ♀.
Hydnobius	5—5—5, ♂ ♀.	Agathidium	5—5—4, ♂.
Dietta	5—5—5, ♂ ?..		5—4—4, ♀.
Anogdus	5—5—4, ♂ ♀.		4—4—4, ♀.
Anisotoma	5—5—4, ♂ ♀.	Agaricophagus	4—3—3, ♂ ♀.
Colenis	5—5—4, ♂ ♀.	Aglyptus	4—3—3, ♂.
Cyrtusa	5—5—4, ♂ ♀.		3—3—3, ♀.
Isoplastus	5—5—4, ♂.	Scotocryptus	3—3—3, ♂ ♀.
	5—4—4, ♀.		
Liodes	5—5—4, ♂.		
	5—4—4, ♀.		

In a study of the above arrangement it will be seen that Scotocryptus follows naturally the course indicated by the genera which precede it. In order that the numerical combinations shall be complete, several new genera will have to be discovered, and the missing genera may be hypothetically indicated, as far as the tarsal structures, by any one whose inclinations run that way.

In the tribe Clambini the tarsi are 4–4–4 in both sexes in the genera known to me.

The antennæ of the Anisotomini exhibit a somewhat similar tendency to numerical modifications: First, by having nine or ten joints; second, by the variation of the number of joints composing the club, being either three, four or five.

ENTOMOLOGICAL NEWS.—*Entomologische Nachrichten* for August is mainly devoted to an article, by J. Schilde, on the secondary causes and relations in the markings of butterflies.——The structure of the halteres of Diptera has been studied by Mr. A. B. Lee. These organs were believed by Leydig to be organs of hearing. It appears, according to the abstract in the Journal of the Royal Microscopical Society for August, that there are two distinct organs contained in each of these structures, one an auditory organ, the other an organ of problematical function, which may be olfactory.——M. R. Zeiller describes the burrows made by the mole-cricket (*Gryllotalpa vulgaris*) in the clay soil at the bottom of a little pool of water that was sometimes nearly dry. These tracts, owing to their arrangement and the marks made on their surface by the insect in traversing its burrow, bear a striking resemblance to the impressions of certain fossil plants. They suggest a comparison with *Phymatoderma liasicum*, and present at the same time an analogy to certain impressions of conifers belonging to the genus Brachyphyllum (Jour. Roy. Mic. Soc., Aug.).——Apropos of the recent changes proposed in the classification of insects, by Packard, Scudder and Brauer, are the remarks of M. Preudhomme de Borre in the Comptes-rendus of the Entomological Society of Belgium for July 4.——The portion in Zittel's Handbuch der Palæontologie relating to fossil insects has been prepared by Mr. S. H. Scudder.

ZOOLOGY.

E. RAY LANKESTER'S CONTRIBUTIONS TO A KNOWLEDGE OF RHABDOPLEURA.[1]—The tube is secreted by the disk or epistome, is wholly external to the animal shut off into chambers, one for each polypide.

The polypides present a body with the disk beneath it, mouth on either side under the disk, an arm with tentacles in a double row upon it, upon the opposite side of the body from the mouth the anus, body shaped like a sack with the intestine coiled and surmounted upon a stalk placed upon the mouth side. All this was known before. Lankester, by sections, demonstrates a space between the body wall and the gut wall partially filled with tissues, probably muscular and connective, which he calls the body cavity. The existence of a body cavity had not before been shown. Also upon the lower side of the main stack of the arms, near their base, L. finds a small ciliated pupilla which he thinks may be an osphradium. The lophophoral arms he considers the genetic equivalents of the ctenidia of Mollusca.

He demonstrates for the first time a sort of cartilaginous mesoblastic skeleton supporting the arms and the contractile cord. Finds the testis, not found by Allman or Sars, a blind sack opening by a special pore; this gonad belongs to Lankester's idiodinic gonads, and is not at all a modified nephridium. Allman's statoblasts are considered by Lankester to be undeveloped buds; buds which from some debility failed to burst through the chitinous tube and mature. In the absence of information upon the embryology, the affinities of Rhabdopleura cannot be definitely spoken upon. If the disk is the homologue of the epistome of Bryozoa, then it cannot be the homologue of the molluscan foot, since its position is dorsal, not ventral, and we may consider it homologous with the mantle, as suggested by Allman.—*Henry Leslie Osborn.*

THE LARGE IGUANAS OF THE GREATER ANTILLES.—The *Iguana tuberculata* is found in the Lesser Antilles, but not in the Greater. Those of Santo Domingo and the islands north and west of it belong to the three genera Aloponotus, Metopocerus and Cyclura. Of each of the first two genera but one species is known, the *M. cornutus* and the *A. ricordii.* Both genera differ from Cyclura in possessing two rows of femoral pores on each thigh, according to Duméril and Bibron. The *A. ricordii* is from Santo Domingo. The *M. cornutus* is said to be from the same island, but the authors of the Erpetologie Generale consider this uncertain. It is certain that some large lizards having a horny tuberosity on the muzzle inhabit that island.

Cyclura, as hitherto defined, does not, in the writer's opinion, differ from Ctenosaura, the species of which inhabit Mexico

[1] Quart. Journ. Mic. Soc., 1884, p. 622.

and Central America. But a character hitherto not recognized does separate the two genera nevertheless. That is the possession, by Cyclura, of corneous combs on some of the posterior digits, specialized from the ordinary lateral scales, which have also comb-like free edges in both genera. The species of this genus known to me are thus defined:

I. Scales of muzzle all small; combs on third toe only.

Several rows of infralabial scuta; five scales on canthus rostralis; crest interrupted at rump only..... *C. carinata* Harl.

II. Large scuta on muzzle; combs on third toe only; one row of large infralabials.

Infralabials and other scuta in contact with each other and with labials; two scales on canthus rostralis; crest much interrupted at nape and rump; color uniform; *C. bæolopha* Cope.

Infralabial and other scuta separated from each other and from labials by small scales; four scales on canthus rostralis; green, with bands.... *C. nubila* Gray.

III. Large scuta on muzzle; one on middle line protuberant; combs on second and third toes; several rows of large infralabials.

Scales regular, distinct on front of body: rudimentary spinous whorls on tail; crest high, interrupted at nape and rump; black..... *C. nigerrima* Cope.

Scales very irregular, minutely granular on scapular regions; no trace of whorls on tail; crest very low, much interrupted..... *C. onchiopsis* Cope.

The *C. carinata* inhabits the Turks island, whence a specimen was brought to Philadelphia by Professor A. J. Ebell in 1868. The *C. nubila* is Cuban. It is the *C. harlani* of De la Sagra's history of that island. The *C. bæolopha* is from Andros island of the Bahama group (see Proceedings of Academy Philada., 1861, p. 123). The *C. nigerrima* is a new species from Navassa, Id., of which a full description will shortly appear in the Proceedings of the American Philosophical Society. It is allied to the *Metopocerus cornutus*. The *C. onchiopsis* is also new to science, and is represented by a large specimen from an unknown locality. On the summit of the muzzle are two pairs of large scuta in front of the median tuberosity, separated by granular scales. In *Metopocerus cornutus* there are said to be three pairs of these scales. This animal also differs from the *M. cornutus* in having eight superior labials; in the nasals being subround instead of triangular; in having a large instead of small symphyseal plate, and in its very low and even imperfect dorsal crest, with a wide interruption between the shoulders. In the typical specimen the temporal muscles are enormously developed, giving the profile a huge convexity behind. Strong longitudinal and transverse gular folds. Color dirty black. The very minute scales anteriorly remind one of the *Aloponotus ricordii*.

From the stomach I took several caudal vertebræ of a mammal as large as a porcupine, and skins of fruits.—*E. D. Cope.*

M. Paul Albrecht's Identifications.—M. Paul Albrecht, in a series of articles, makes some startling identifications of homol-

ogy between parts of the mammalian skull and elements present in the lower vertebrates.

By a course of reasoning based upon the examination of skulls in which ossification was defective at some point or other, this anatomist has found the quadrate bone of reptiles to be present in mammals in its normal position, but to synostose with the squamosal early in life; he has found the symplectic of the fish in the malleus of the mammal; he identifies the piscean hyomandibular with the incus, os orbiculare and stapes, basing his identification on an actual division of the columella which is known to occur; he finds the metapterygoid transformed into the squamosal; while he sees the ectopterygoid of the fish in the mammalian alisphenoid, the entopterygoid in the pterygoid and the preoperculum in the tympanic bones.

MM. Serres, Rambaad, Renault and Ihering agree in homologizing the postfrontal with the external orbital hypophysis of mammals, and M. Albrecht agrees in the identification.

In a communication relating to the "epipituitary spondylocenters of the skull" he traces the remains of the primitive passage of the dorsal chord through the series of vertebræ which form the basicranium. After leaving the basiotic part of the occipital, the passage, according to M. Albrecht, continues *above* the hypophysis in the clivus (dorsum sellæ) of the basipostsphenoid, and thence through the basipresphenoid, basiethmoid and basirhinoid or cartilage of the nose. M. Albrecht speaks of an adult mammal in which this basirhinoid was traversed throughout its whole length by the chorda dorsalis. In some cases (*Rhinoceros tichorhinus*) it may ossify as one bone, in others as a series of centers of vertebræ. Between these bones (cranio-style Albrecht) and the atlas our author counts seven vertebral centers, namely (counting backwards from the basiethmoid), the basipresphenoid, *basihypersphenoid*, *basianasphenoid*, *basiepisphenoid*, *basiorthosphenoid*, basiotic and basioccipital. The dismemberment of the basisphenoid into the four bones the names of which are italicised, is deduced from peculiarities found in certain mammalian skulls. Another result of this course of reasoning is the homologizing of the teleostean parasphenoid with that part of the basipostsphenoid which is not included in the clivus, and another that the trigeminal nerve of the Mammalia leaves the true cranium at the same spot which it pierces in the non-mammalian gnathostomes. A profile of the head of a fish is placed above a schematic figure of the lower jaw and temporal bone of an infant to show the perfect correspondence of the connections of the meta- and ectopterygoid bones with the alisphenoid and squamosal, and of the quadrate with the lower part of the same temporal. The symplectic and hyomandibular have, according to our author (Sur la valeur morphologique de la trompe d'Eustache) nothing to do with the hyoid arch. The mere fact that the

symplectic gives origin to the cartilage of Meckel shows that it must belong to the mandibular arch. Besides this, the hyoid arch, in the rays, is attached behind these bones. The relations of the hyoid and mandibular arches to each other are traced through the various classes, and M. Albrecht maintains that the metapterygoid (squamosal), quadrate (quadrate part of temporal), ectopterygoid (alisphenoid), entopterygoid (pterygoid) and palatines form a premandibular visceral arch or rib. From this it follows that the spiracles (of selachians) and the eustachean tube are morphologically a premandibular branchial sac. Such branchiæ, in fact, exist in the spiracles of selachians.

M. Albrecht has recently returned to the attack in the *Biologischen Centralblatt*, in which (IV Band, Nr 23) he endeavors to prove from Fig. 308 of Kolliker's Entwicklungsgeschichte des Menschen und der hoheren Thiere, the correctness of his belief in the non-existence of Rathke's pouch. In the same periodical, (V Band, Nr 5 and 6) he records the discovery of seven bony vertebral centers in the cartilaginous nasal septum of a full-grown cow. His figures certainly shows seven small bones, in so far approximating an anterior tail.

In some observations recently made by our author before the Brussels Anthropological Society he treats of the posterior termination of man's vertebral column. Man, he says, is a tailless lower ape or lemur. Atavisms going back to the lemurs are more common in man than in any monkey. Through want of use he has lost "that registrar of the state of the mind," the tail. Yet man has really six or seven caudal vertebræ, two anchylosed with the three sacral vertebræ which enter into the sacro-iliac articulation, and four or five (in woman often five) coccygeal vertebræ. M. Albrecht maintains that post-coccygeal proto-vertebræ exist in some cases, and even believes in the occurrence of bone in the same region.

In another article our author gives figures of the manubria of six examples of Mycetes. In one only is the manubrium entire, and M. Albrecht correlates the fissured manubrium with the howling habit of this genus, necessitating space for the larynx.

In a memoir with the title, Intercostal Copulæ, Professor P. Albrecht reasons out and illustrates with diagrams and representations, the method of union between the paired processes of the vertebræ and the mode of origin of the sternal segments. He divides these processes into ribs (costæ) and costoids. The ribs are intermyocommatic, the costoids are interprotovertebral. The dorsal costoids are styled diacostoids; the ventral costoids, paracostoids. These costoids have their own center of ossification; when this is not the case they are replaced by di- and par-apophyses. Any adjacent pairs of ribs or costoids upon the same side may be conceived to unite while still cartilaginous. These two opposite pairs may unite. Osseous tissue may develop in each

copula. This finally results in a sternebra which is intercostal, or intermediate between two successive pairs of ribs. A succession of these intercostal copulæ between the true ribs form a sternum. Just as the true ribs are linked by copulæ that are intermediate between two adjacent pairs, so are the costoids linked by intermediate copulæ, which may thus be distinguished as intercostoidal paracopulæ and diacopulæ. These par- and diacopulæ may develop between par- and diapophyses as well as between par- and diacostoids.

The views of M. Albrecht with regard to the evolution of what may be termed rib-junctions appear very plausible, but he coins some terrific polysyllables to explain their co-relations, as witness "diparatetradiacopulaire." This is worthy of organic chemistry.

PRESENCE OF A TAIL IN THE HUMAN EMBRYO.—Does the human embryo ever present at the posterior extremity of its body anything which deserves the name of a *tail?* This question has given rise to a debate which has not failed to be a lively one because necessary distinctions had not been made by the disputants, and because they did not confine themselves to a strict definition of terms.

It is at the outset necessary to distinguish between teratological cases and normal embryological phenomena; then it is necessary to agree as to the meaning of the word *tail.* Is this term applicable to any conical or cylindro-conical appendage of the posterior extremity of the back, formed of the tissues composing it, or should we reserve it for an organ containing a prolongation of the vertebral column? It is this last definition which should prevail; an appendage deprived of vertebræ is not a true tail in the anatomical sense of the word, but a simple caudal prolongation.

In the teratological cases described by MM. L. Gerlach, Bartels and Ornstein, the appendage, sometimes filiform, sometimes voluminous, does not contain an incontestible vertebra, and the total number of these osseous pieces does not pass beyond the regular number of normal man.

As regards young embryos it is impossible to decide the question if at the outset we do not determine the point where the caudal vertebræ begin. Should we place the limit at the point where the tail leaves the body? or should we be guided by the position of the anus? or better still should we call *caudals* all the vertebræ situated behind the sacrum? It is this last view which has prevailed in comparative anatomy, and we can say from this point of view that adult man possesses a tail, since it presents four or five coccygeal vertebræ situated behind the sacrum. The minimum, in this relation, is attained by the chimpanzee, which has only two or three coccygeal vertebræ.

Should we wish to apply the name of tail to the portion of the

vertebral column situated behind the trunk, it would be necessary to bear in mind that from the age of three weeks and up to that of two months and onwards, the human embryo is fortified with this organ, because at this epoch the coccygeal vertebræ occupy the axis of a very distinct cylindrico-conical appendage, and which arises from the posterior extremity of the trunk. If, with M. His, we take for our guide the position of the anus, the tail will be shorter, but it will not cease to be very apparent, especially at the age of five or six weeks.

However, it is admitted as absolutely demonstrated, that this caudal appendage of the human embryo never contains any other vertebræ than those which are found in the coccyx of the adult. Ecker, who has given, with conviction, the name of tail to the posterior extremity of the human embryo, has declared that he has never met with supernumerary vertebræ. This author has himself studied the tail, very well formed, of a human embryo of 9^{mm} in length, and he describes and figures all the terminal part as constituted of an unformed blastema. M. His found there, however, a prolongation of the dorsal cord and spinal marrow, but no segmentation. Both admit that beyond the thirty-third or thirty-fourth vertebra there is no other portion of the skeleton. On this capital point my researches have led me to a result diametrically opposed to that of my predecessors. The errors of M. His arose from the fact that the embryos, the more advanced of which he made the reconstruction, those of 7^{mm} and a fraction, have precisely thirty-four myomeres, viz., thirty-three vertebræ, and he admits, without any other proof, that he was working over a definite stage.

I have had the honor of presenting to the academy a résumé of my anatomical study of a human embryo of $5\frac{6}{10}^{mm}$, viz., one twenty-five days old. This embryo had no more than thirty-three somites, representing thirty-two vertebræ. There is then an increase of the number during the fourth week. This fact led me to seek whether this number might not increase still more during the fifth week, and my attempt did not fail! The human embryo of 9^{mm} to 10^{mm}, the age when the tail reaches its maximum length, *possesses a number of vertebræ greater than that of the adult.*

Two embryos of better appearance and perfectly fresh at the moment when they were sent me, have been photographed, and then treated with reagents and cut into microscopic sections. The series of sections are irreproachable, and one of the two sets, comprising 320 sections, has been entirely drawn, with the greatest pains, with the camera lucida. In comparing these 320 drawings it is easy to count, without any chance of error: 1st, the rachidian ganglion; 2d, the myomeres; 3d, the cartilages arising from the bodies of the vertebræ. These three counts control and mutually confirm each other, since all three give the same result, the human embryo of 8 to 9^{mm} has thirty-eight vertebræ.

This result is also confirmed by the examination of photographs of fresh pieces, for then can be easily distinguished thirty-five myomeres and, besides, a region occupying the outer fourth of the tail, where the limits are no more visible across the skin. But the sections prove to us that in this last quarter, contrary to the opinion of Ecker and of M. His, the mesoderm is divided with the greatest clearness into a double series of somites which extend to the last extremity of the tail, but presenting, it is true, dimensions regularly decreasing up to the thirty-eighth somite, which does not measure more than thirty-seven microns in diameter.

This fact is in no way teratological; it is plainly confirmed by several other embryos which I possess, all perfectly normal and of ages slightly different.

With the exception of the two last, all the caudal vertebræ have a blastema of a cartilaginous body similar, except in its dimensions, to that of any other vertebra of the series. The two last are only indicated by myomeres, perfectly distinct from the rest. The extremity even of the tail is formed by the termination of the medullary tube, only covered by the skin. The dorsal cord also extends very near this extremity.

The last caudal vertebræ have only a very ephemeral existence; already in embryos of 12^{mm} in length, viz., six weeks old, the thirth-eighth, thirty-seventh and thirty-sixth vertebræ become confounded in a single mass, and the thirty-fifth itself is not perfectly limited. An embryo 19^{mm} in length has no more than thirty-four vertebræ, the thirty-fourth evidently resulting from the fusion of the last four; at this period the tail as a whole is already much less prominent.

It results from these facts that the human embryo during the fifth and sixth week of its development, is provided with an undoubted normal tail which in form is regularly conical, elongated and which deserves, under all relations, the name which I have given it. This organ, evidently deprived of all physiological utility, should be classed in the number of representative organs. —*Professor H. Fol, in Comptes Rendus de l'Acad. Francaise, June 8, 1885.*

Zoological News.—*Echinoderms.*—Professor. F. J. Bell (Proc. Zoöl. Soc., Dec. 18, 1883) describes *Anomalanthus lumidus*, a species of echinoid first described by the Rev. J. E. T. Woods as an Echinanthus. As the ambulacral pores are arranged in rows which are not closed or quite parallel, and which show a tendency to spread at their distal end, and as the under surface, though with the ambulacral sutures of Echinanthus, has not those sutures converted into conspicuous grooves, Professor Bell makes it the type of a new genus. It is found upon the eastern coast of Australia.——As one of a series of contributions to the systematic arrangement of the Asteroidea, Professor F. J. Bell (Proc. Zoöl.

Soc. London, 1884) gives a monograph of the genus Oreaster. He allows twenty-seven species, including *Nidorellia armata* of Gray, and gives a full description of each, with habitat, etc.

Mollusks.—Dr. Gwyn Jeffreys (P. Z. S) describes seventy-four species of Littorinidæ, Scalaridæ, etc., gathered by the *Lightning* and *Porcupine* expeditions. A large proportion are new.——Professor B. Sharp, in an address before the Biological section of the Academy of Natural Sciences of Philadelphia, gives the following as the development of the molluscan eye: (1) A pigmental surface of epithelial cells, as in Ostrea; (2) pigmented invaginated grooves for protection at centralized points of the body, each visual, all having a cuticular body, as in *Solen vagina* and *S. ensis;* (3) a sphere made of pigmented cells, the sphere formed by the contraction of the groove, as in Patella; (4) a cuticular lens formed by the centralization of the refractive bodies of each cell, as in Haliotis and Fissurella. In both these genera there is a distinct nerve of sight connected with the superior cephalic ganglion.——Mr. Chas. E. Beecher (36th report N. Y. State Mus. Nat. Hist.) describes some abnormal and pathologic forms of fresh-water shells. He figures a sinistral *Planorbis exacutus,* which is monstrous in every particular, and another with an expanded aperture, also abnormal examples of *Physa ancillaria, Valvata tricarinata, Gillia altilis, Somatogyrus subglobosus, Unio pressus, cariosus* and *complanatus.*——Professor B. Sharp maintains that the lens of the eye of the Vertebrata is homologous with a primitive invaginated eye, such as we now find in the Gastropoda, and that the layer of optic fibers of the retina is homologous with the primitive optic nerve. If the lens is the sphere of the mollusk, and the fibers of the retina the primitive optic nerve, the retina or ganglion opticum must be regarded as formed by an outgrowth of the brain, and the optic nerve of the vertebrate is really a secondary optic nerve.

Fishes.—Mr. W. R. O. Grant (Proc. Zoöl. Soc., 1884), contributes a revision of the fishes of the genera Sicydium and Lentipes. The first genus occurs throughout the torrid zone in fresh waters near the sea, and contains twenty-four species, five of them new to science. Lentipes occurs in the rivers of the Sandwich islands, and equals Sicyogaster Gill. Two species are known.

Reptiles.—Professor W. K. Parker (Trans. Zoöl. Soc. London, 1883), in his account of the structure and development of the skull in the Crocodilia, remarks that the skull of the Sauropsida is a mere specialization of the underlying ichthyic type. He considers that in some very important things the skull of the anurous Amphibia forms a better leading step to the mammal than that of the Sauropsida. The Crocodilia show in the earliest stage a compound nasal labyrinth. Only three of the visceral arches are developed, and only the first attains full size. In embryos from one and five-

sixths to three and one-half inches long the whole of the chondrocranium, with its visceral arches, has become sauropsidan, and the investing bones are quite crocodilian in number and relation. The chondrocranium is better developed than in any existing reptile or bird. The mandibular arch in the crocodile is the culmination of the oviparous type. In the early stages the mandibular suspensorium is extremely like that of the more generalized selachians. There is a distinct suprastapedial element in the hyoid arch.

Birds.—The "cape wigeon" of Latham, and *Anas capensis* of Gmelin, is noted by T. Salvadori as occurring in Shoa. It is redescribed as *Querquedula capensis.*——Mr. R. B. Sharpe describes an apparently new nuthatch (*Sitta whiteheadi*) from the mountains of Corsica.

EMBRYOLOGY.[1]

ON THE GENESIS OF THE EXTRA TERMINAL PHALANGES IN THE CETACEA.[2]—In what manner the extra terminal phalanges of the second, third and fourth digits of the manus of such a type as Globiocephalus amongst Cetaceans, was evolved, has been a question which my studies gave little hope of satisfactorily answering until I had noticed that the bony digits of both the manus and pes in the pinnipeds are prolonged into the flat terminal integuments of the limbs far beyond the nails as unsegmented bars of cartilage, which are really unossified extensions of the ungual phalanges. The nails are borne upon the dorsal aspect of the ungual phalanges in pinnipeds, the ossified shafts of these phalanges usually ending abruptly to be continued into the terminal bars of cartilage. In Histriophoca the terminal cartilaginous extension of the last joints of the digits are quite rudimentary, but the point where the ungual phalanges abut distally upon the terminal cartilages is still visibly marked in this species. In the walrus, the fur-seal and sea-lion the terminal cartilages of the digits are more developed, and articulate directly with the abruptly truncated ends of the ungual phalanges. In the manatee the ungual phalanges of the manus terminate abruptly; that they support cartilaginous extensions of notable length seems improbable. The terminal cartilages of the digit apparently reach their greatest or strongest development in the walrus.

The foregoing data when interpreted by the aid of embryological theory, as actually observed to hold in other forms, and linked with the explanations afforded by other facts which will be given later on, will, it seems to the writer, gives us a rational hypothesis of the origin of the extra-terminal digits in the manus of the whales.

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

[2] This note presents the substance of conclusions reached by me in my memoir entitled, "On the development of the Cetacea, together with a consideration of the probable homologies of the flukes of cetaceans and sirenians," now in press.

That the digits of the Cetacea develop as part of the continuous blastema of the embryonic appendicular skeleton as in other vertebrated animals, there can be no doubt. That the joints and segments of their limbs also become gradually defined in serial order from the shoulder and hip girdles outward, also admits of no doubt, as may be seen upon studying sections of the manus, a quarter inch in length, of a fœtal Globiocephalus two inches in total length. In like manner there can be no doubt of the fact that the cartilaginous extensions of the ungual phalanges of pinnipeds are a part of the original blastema from which the ossified portions of the skeleton of the limbs of these animals has developed.

In man the shafts of the three phalangeal segments of the digits of the manus ossify almost contemporaneously. In Globiocephalus, on the other hand, in a specimen one-third grown, it is found that the proximal segments of the second and third digits ossify apparently at about the same time as their isomeres in the first, fourth and fifth digits, whereas the distal or *extra* peripheral segments develop ossific centers enchrondrally much later. These data, therefore, indicate that the extra terminal phalangeal segments of the Cetacea have been added to the digits of the manus since the three proximal ones have been formed, which are normally characteristic of the digits of other mammals.

In fact, the development of the manus of Globiocephalus shows that while the metacarpal elements and first three or four phalangeal segments of the second and third digits ossify simultaneously, the four to six extra distal segments ossify in succession towards the distal periphery, the terminal elements of the digits being the last in which ossific centers appear.

Granted, then, that the extra terminal digital segments of the whales are ontogenetically as well as phyletically of later origin than the proximal ones, the only source from which it is possible to conceive them to have been derived is from such cartilaginous extensions of the ungual phalanges of some ancestral seal-like form, or from the cartilaginous extensions of the digits of the Protocetacea, which may for our purpose, be considered to represent a hypothetical type. These cartilaginous extensions, if segmented a number of times, would afford the basis for the development and ossification of the extra terminal digits of the existing whales. In fact, in some of the existing seals these cartilaginous prolongations of the ungual phalanges are long enough in the pes to afford the basis for three new and additional segments to each digit, as long as the three normally developed in each toe.

The proof that the extra terminal segments of the digits of the cetacean manus have been added distally, is the fact that the structure of the carpus is not, in any essential feature, different in structure from that of other mammals so far as the presence or

absence of elements normally formed is concerned. I am therefore constrained to believe that it has been through a seal-like ancestry with prolonged integuments to the manus, in which the nails were not terminal but dorsal, beyond which the ungual phalanges were extended as bars of cartilage, which gave rise, by transverse segmentation and subsequent ossification to extra terminal digital segments as found in existing Cetacea.

The second fact of importance to be considered as lending probability to the foregoing view is the circumstance that when a limb is in its primitive cartilaginous condition it always develops its segments from its axial end toward its peripheral end in serial order. The basis for the extra terminal segments was first developed through the influence of functional adaptation, as cartilaginous bars or extensions of the primitive cartilage of the ungual elements of the digits in response to the demands made upon the limb in swimming. The segmentation of these terminal cartilaginous bars then followed through the influence of mechanical strains acting upon the cartilaginous terminal bars as these were alternately bent in opposite directions. These conclusions might be still further illustrated by data obtained from the observation of the development of the limbs of other animals.

These views, very forcibly it seems to me, sustain the hypothesis that the Cetacea are the off-shoots of land forms which were at first terrestrial, or at least amphibious, as are the pinnipeds. Such views do not at least run counter to any morphological facts, but in reality are sustained by them.—*John A. Ryder.*

ON THE MANNER IN WHICH THE CAVITY OF THE HEART IS FORMED IN CERTAIN TELEOSTS.— Balfour (Comp. Embryol., II, 523) states that "in Teleostei the heart is formed as in birds and mammals by the coalescence of two tubes, and it arises before the formation of the throat." I would now point out that this is not universally true of all teleostean forms, in fact it seems not to be the mode of cardiac development in any species of this group so far investigated.

My own observations on this point have been made upon the embryo cod-fish,[1] and indicate very conclusively, so far as transparent views are of value in deciding such a difficult matter, that the lumen of the heart arises as a single and not as a double cavity which afterwards blends to form a single one, as in birds and Mammalia. Moreover, this cavity is from the first open below, and is present in the cod embryo, on the fifteenth day, as a round opening limited all round by mesoblastic cells. Its transverse diameter at this stage is .043$^{mm.}$ and is probably half as deep. It has the appearance of a round perforation in the mesoblastic plate of cells which probably gives rise to the endothelium of the cardiac cavity, the lining of the pericardial cavity and

[1] Contrib. Embryog. Oss. Fishes, pp. 82–86.

muscular wall of the heart, and which underlies the fore-gut as a transverse band of tissue. The cardiac lumen, as observed by myself to appear in the living embryo, occupies, *ab initio*, such a position that the median vertical plane passing through the embryo lengthwise would divide it.

Its floor, which corresponds to its future venous end, seems to be devoid of cells, and is formed apparently by the periblast covering the yolk. In the later stages of cardiac development in forms which have no complete circulation at the time of hatching, this is invariably the case, the venous end of the heart opening directly upon the surface of the periblast, as is shown in longitudinal sections of such stages.

As elsewhere stated, the yolk is here absolutely excluded from the intestine, and the arrangement above described then provides the passage-way for yolk material into the general circulation as it is segmented off from the periblast, as shown by Kupffer, Gensch and myself. This also bring the segmentation cavity and the blood vascular channels into actual continuity.

The investigations of Hoffmann[1] upon the development of the heart in Salmo are based entirely on sections, and begin with a stage long prior to the time when the organ begins to pulsate, and corresponds pretty closely to the stage of development seen in the cod embryo described above, which was observed about two days before pulsation began, when the heart became for the first time distinctly tubular, its lumen in the early stage here considered, being a mere flat, discoidal vacuole with vertical side-walls formed of cells. At a later stage of development the axis of the lumen of the cardiac cavity is horizontal instead of vertical.

Hoffman concludes that the endothelium of the heart is derived from the hypoblast, in which a short tubular cavity at once appears, the long axis of this endothelial tube coinciding in direction with the axis of the embryo. The myocardium or muscular outer wall of the heart is derived from the splanchnopleural plates which grow on either side of the embryo from above downwards and inward under the fore-gut, below which they approximate, their free ends finally investing the endothelial vesicle or tube, which represents in the salmon the vacuole above described in the cod embryo, which is the first trace of the cardiac lumen. After the muscular layer of the heart is supplied by the splanchnopleural plates, the foundation of the structure of the adult heart has been laid.

In neither of the foregoing accounts is there anything which suggests very much similarity between the mode of development of the first traces of the unpaired rudiment of the teleostean heart and that of Aves or Mammalia which arises by the fusion in the median line of a pair of cavities on either side of the lat-

[1] Zur Ontogenie der Knochenfische, Pts. VII, VIII. Amsterdam, 1882.

ter, which are for a time shut off from each other by a septum.—*John A. Ryder.*

PSYCHOLOGY.

CURIOSITY OF MONKEYS.—"Do monkeys learn by experience?" is asked in your last number by Mr. W. H. Frost, who cites cats as learning in regard to their reflection in a mirror, and further states that it is claimed, on tolerable good authority, that monkeys never do, which statement he does not attempt to answer.

It seems to me that the probable explanation of the difference of action of the two animals in the matter is due, not to the superior powers of discernment, and capacity of learning by experience possessed by the cat, as one would infer from the article mentioned, but just the reverse.

I should doubt very much but that the monkey realizes in time that there is no other individual behind the glass, and think that its actions are simply due to the greater mental development which it possesses, and which is largely manifested by its investigative turn of mind, and could we understand the monkey language, it would tell us that it was a problem which it was trying to work out, and that while it felt that it was no genuine or ordinary monkey which appeared in the glass, it was curious to find out just what it was.

The monkey's mind, from long experience, has an innate consciousness of power to solve many of the problems presented to it, and being in a comparatively active state of evolution, is continually grasping out at new ideas.

The cat's mind, on the other hand, is not of such a progressive type, and consequently it quietly gives up many problems with "I cannot comprehend," and ceases to "bother its head about it," simply accepting the problem as it appears to it—a harmless, unexplainable phenomenon.—*Eugene N. S. Ringueberg, Lockport, N. Y.*

THE INVERNESS DOG "CLYDE."—Further letters respecting the Inverness dog "Clyde" tend to increase our respect for the sagacity of that individual. Its owner asserts that he taught himself to go to the baker's shop with money, and that he does intentionally and knowingly steal, hiding the money in his mouth. He will often hide some pieces in some corner known only to himself, ready to spend on occasion. If told to raise his head he will however, do as ordered, and the donor can then put the money in the box. A particularly innocent look upon his face indicates to his owner that he has money in his mouth, but he will disgorge when commanded. On one occasion when he was ordered to come to receive the punishment due for disobedience, he sprung into the canal instead; and, on another, when told to go to the baker to get some water to drink, he brought a tin bowl out of the back room and set it down before the baker, looking at him as if to say, "Don't you see what I want?"

ANTHROPOLOGY.[1]

THE EIGHTH VOLUME OF THE TENTH CENSUS.—In this ponderous quarto are four papers with different pagination, to wit: Newspapers and periodicals; Alaska; Fur Seal islands, and Shipbuilding. We are here concerned with the third, which bears the title, Report on the population, industries and resources of Alaska, by Ivan Petroff, special agent, pp. 190. The following named maps interest the ethnologist: Ethnological map of Alaska, maps showing distribution of fur animals and timber. Six colored plates illustrate the social life of the people.

For the purpose of enumeration and description the Territory is considered in the following six divisions:

1. The Arctic division. Arctic watershed east of C. Prince of Wales.
2. Yukon division. Valley of the Yukon river.
3. The Kuskokvim division. Valleys of the Kuskokvim, Togiak and Nushegak rivers.
4. The Aleutian division. Aliaska peninsula west of the isthmus, between Moller and Zakharof bays and the chain from Shumagrin to Attor, including the Pribylof, or Fur Seal islands.
5. The Kadiak division. South coast of Aliaska to Zakharof bay, Kadiak group, Cook's inlet, Kenai peninsula and Pr. Wm. sound.
6. South-eastern division. From Mt. St. Elias to Portland canal, in lat. 54° 40′.

Each one of these divisions is taken up separately, the people mentioned and located by settlements, and the population given.

In the Arctic division the people are all Eskimo, or Innuit.

In the Yukon division 4276 enumerated are Eskimo, and 2557, living on the river basin away from the sea, are of the great Tinné, or Athapaskan stock.

In the Kuskokvim division 8036 are Eskimo, 506 Athapaskan, 255 Aléut and 114 whites and creoles.

In the Aleutian division 1890 belong to the Aleutian, or Unungan stock, 561 are whites and creoles. No Eskimo exist in this area.

In the Kadiak division 321 Thlinkit, or Kolosh Indians, 864 Athapaskans, 2211 Eskimo and 951 whites and creoles.

In the South-eastern division 788 are Haida, or Queen Charlotte stock, 6437 Thlinkit, 523 whites and creoles. The Thlinkit stock of this division includes the tribes called Chilkhat, Hunyah, Khutz-na-hu, Kehk, Auk, Taku, Stakhin, Prince of Wales, Tongas, Sitka, Yakutat. The Haida tribes of this division all live on Prince of Wales island.

Although the author has a chapter on Alaskan ethnology (123–177) replete with information upon the social life and arts of the people, every other portion of the monograph abounds with invaluable matter. Indeed, there would be no hesitation in saying that this chapter of the census will remain for a long time an ethnologic text-book on Alaska.

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

TEXAN MOUNDS.—Mr. Pierce, Episcopalian bishop of Little Rock, Ark., states that in the old bottom of Red river, south of its present course, between Rocky Comfort, Ark., and De Kalb,[1] Texas, an extensive series of unexplored mounds can be found. When he saw these mounds, while riding by in a carriage, they appeared to him of almost uniform size and flat on the top, about sixty feet wide and eighty long, with a height varying from eight to twelve feet. They were oval with the long sides lying parallel to each other, and a portion of them projected into the brush-wood, so as to be only partially visible. To state the number of these artificial structures is impossible, but it took an hours' ride before he had passed the last of them.

ANTHROPOLOGICAL COLLECTORS.—In every department of science one of the most valuable requisites is the collector. When his material is assorted and put away for research or put on exhibition for educational purposes, almost the only value which the specimens have is the little piece of paper he attaches to them. It is well known that specimens are assorted and arranged by certain classific concepts, such as locality, tribe, structure, function, and evolution. Now, suppose a collector is going over the eastern, or the western coast of North America, and from one place brings a large quantity of mortars and pestles, from another, basket work in the greatest profusion, from another, pottery, and from a fourth, bows and arrows of a pattern which he regards as unique. These are brought home and laid on tables according to the locality concept. We see at once what a chapter in human history we can write. Tribe A grinds its food, tribe B does nothing but make baskets, tribe C has no other vessels but pots, and tribe D is altogether addicted to the chase. It is impossible to say beforehand to a collector, get this or that, for we do not know what he is going to find. If we say, get everything, or at least a sample of everything, he is at a loss to decide which to select. One very good rule for a collector to follow is, *Perfect each observation.* It is better to know all about something than to know a little about everything. "Blessed is the man that's well smattered," does not apply to collections. In the case of any human art whatever, it is essential to have the raw material, together with accurate descriptions of all the customs and superstitions connected with its procurement and preparation. The next thing is to find out who are the agents, men or women? all or some? always or sometimes? everywhere or somewhere? This should be followed by the scrupulous procurement of all the tools used in all the steps from exploitation to exchange or consumption. Nor would these be very useful without photographs, models, and descriptions of all the processes involved, without, in short, exhaustively answering the

[1] Bowie county, Texas.

question *how*. Finally, the finished product of each art should be procured in all the types of its manifestation. I know one man who collects only the rudest products of each art. I know many more who are wasting fortunes on *chef d'œuvres*, and, I am proud to say, there are very many private collectors who are engaged in exhausting a special theme up to the limit of their means. In 1875 I prepared a little pamphlet for Centennial collectors in which I dwelt particularly upon this point. Some of the material procured for that great exhibit was gathered by the rule that we must have all of a thing or none. Lately some of the mound-explorers have proceeded on the same plan. But, alas, the old raking-in process is also largely in vogue, and future museum students will have a happy time in guessing what manner of people those ancients were. I have lately opened a large lot of relics from old Peruvian cemeteries, in which the transmitter says, "You will doubtless know all about these things." In emptying some of the pots and gourds I came across a large beetle, nearly two inches long, transfixed with an entomologist's pin, the latter very much rusted. Now, can any body tell me whether the Incas were so advanced in culture as to make collections of insects and to preserve them on pins exactly like those in use forty years ago?

Anthropology is fast becoming an exact science, thanks to the noble army of collectors who have known how to see, delineate, collect and describe; but there is still room for improvement. I do not mean that we must become the victims of professional collectors, The much better way is for every lover and student of this science to exercise the greatest wisdom on his own behalf, to do his own collecting as far as possible, and to submit other material to the most rigid scrutiny.

PUJAHS IN SUTLEJ VALLEY.—In nearly every Himalayan village there is a house for the representation of the local divinity. In front is a shed formed of four pillars, and a roof of wood ornamented in the style of the temple. This is both a resting place for travelers and the scene of some of the ceremonies connected with worship. In each of the temples is kept a framework (called devi) hung with pieces of silk variously colored, looking like a shrine. This is borne by staves over which a red cloth is hung, drooping to the ground on either side and covering the staves except where they rest on the bearers' shoulders. Above the level of the staves, and around the central post are masks of gold or brass. The central portion is surmounted by a mass of yak's tails dyed red. Similar forms are found in other parts of the mountains. At times the devi is taken out for an airing, when the people wash themselves and their clothes. The ceremony was a peculiar dance in the porch of the temple, during which the devi was carried round by two men facing each other. The villagers faced the litter in a semicircle, their arms intertwined. The end man

had his right hand free, and in it he held a *chowrie* (brush of yak's tails) with which he kept time. At another ceremony an old man in the red robe of a lama approached the devi, and washed the masks with mint and water, offering incense, flowers, fruit, and bread. A number of birds, some black, some white, were killed, and the blood sprinkled on the devi, afterwards the rest was dashed over the building. A part of the service was a mock battle with walnuts and pine cones, between the priest and his attendants from the balcony of the temple, and the people below. Meanwhile the birds were cooked, and they are now served, the women eating first. The devis have a way of intimating when they wish to go visiting. The reception of one devi by another is like two rajahs meeting. There is a great amount of bowing and shaking which terminates in the host getting behind and the procession marching to the village temple. When the visitor returns home the host accompanies it to the borders of the village. Mr. Simpson, who describes the pujah ceremonies first draws attention to the ark and sacrifices of the Jews and the Egyptians, and then views with more favor the car-festival as the parent of these primitive services. To most people unacquainted with India the rath yatra, or car-festival, is associated only with Jagganath, at Puri, but this is not so; cars are kept in the temples over the whole of Southern India. Although not connected with Hinduism, the Buddhists also had a similar festival. If it was common to the whole of India, it is easy to see that where there were no roads for a car on wheels, the god would have to be carried on men's shoulders, and the size would be reduced to suit circumstances. At one of the pujahs a Brahmin walked barefooted thirty steps on the sharp edges of hatchets.—*J. R. A. Soc., XVI., 13–30.*

THE KANSAS CITY REVIEW.—One of our best sources of information respecting the archæology of the Missouri region, is the *Kansas City Review*. The editor, Mr. Theo. S. Case, has conducted this journal for seven years, at considerable expense to himself, in order to contribute his share towards the intellectual improvement of his section. There is a rumor that the *Review* is in danger of stopping through want of patronage. We regret to hear this very much. The late Dr. Ruggles said to the writer on one occasion, "I do not read half the books and magazines I buy. I take them because I am afraid the authors would suffer without my little help." Now this is one motive, and there are many more why we should not let good scientific literature languish through lack of our aid.

MICROSCOPY.[1]

TREATMENT OF THE EGGS OF THE SPIDER (*Agalena nævia*).—The eggs of our common grass spider (*Agalena nævia*) are de-

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

posited in white silky cocoons, which are attached to the under side of loosened bark, fence boards, and other sheltered places. They are very abundant in September and October, and during the entire winter cocoons may be found with eggs in early stages of development. This species thrives well in captivity, so that there is no difficulty in obtaining eggs freshly laid.

For studying the egg in a living condition the long-used method of immersion in oil is excellent. The oil should be perfectly clear and odorless. The external features can be studied to better advantage by mounting the eggs in alcohol after they have been freed from the chorion and stained. Another valuable method for surface study consists in clearing the already stained egg in clove oil. The thickness of the blastoderm is most easily determined in this way.

The best method of hardening preparatory to sectioning is that of heating in water to about 80° C., and then, after cooling slowly, treating with the usual grades of alcohol. Good results were obtained with Perenyi's fluid, which rendered the yolk less brittle. Osmic acid does not penetrate the chorion, and chromic acid or acid alcohol are not easily soaked out on account of the thickness of the chorion.

Borax-carmine proved, on the whole, to be the best staining fluid. It is difficult to make the dye penetrate the chorion, and, after hatching, the cuticula forms a similar obstacle. This difficulty may be overcome by prolonged immersion in the staining fluid. In some cases seventy-two hours were required to obtain a sufficient depth of color. In order to avoid maceration, which would result from so long continued immersion in a weak alcoholic dye, the staining process may be interrupted at the end of every twenty-four hours, by transferring to seventy per cent alcohol for an hour or more.

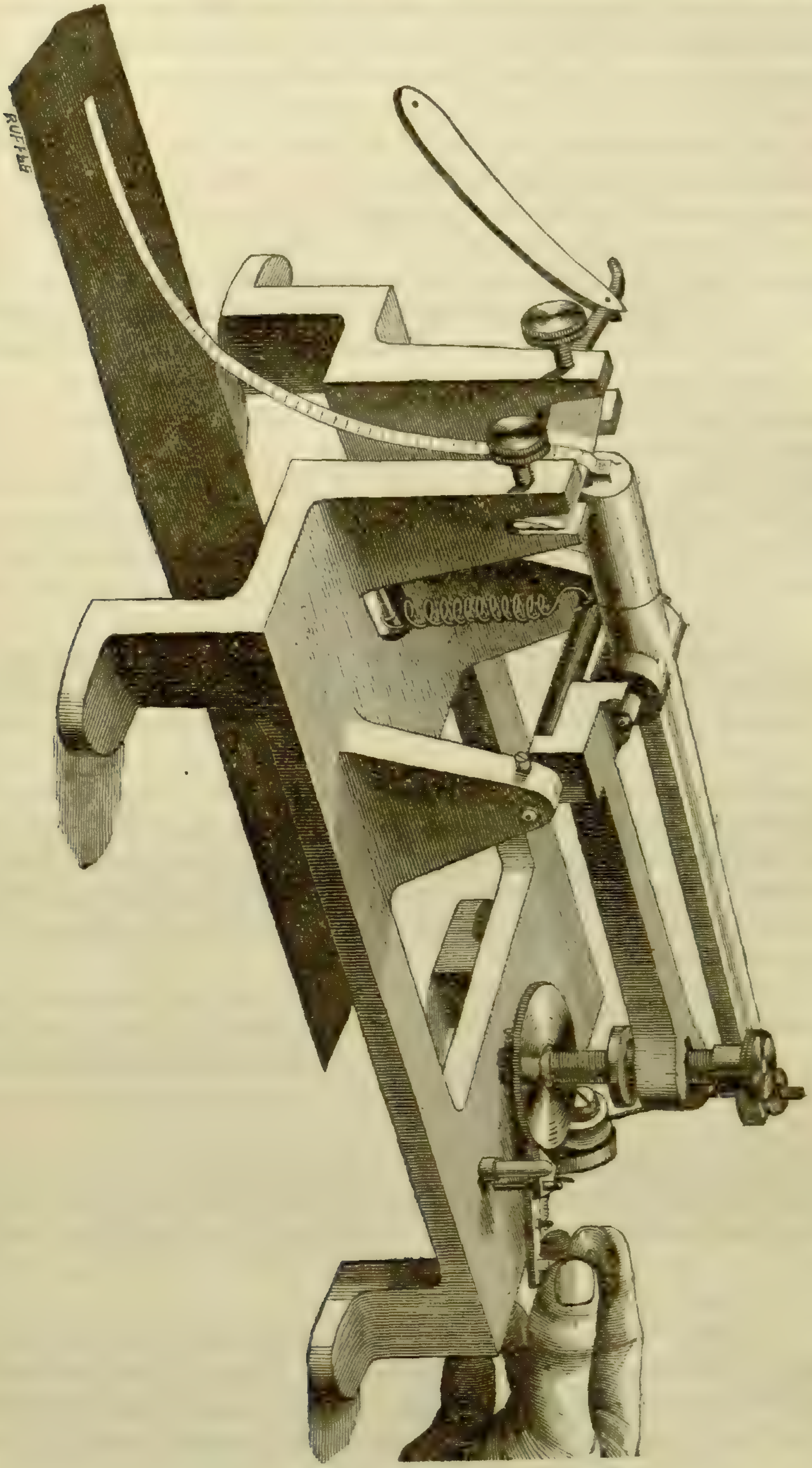
After most methods of hardening, the yolk becomes very brittle, and the sections crumble. This difficulty may be overcome by collodionizing the cut surface before making each section, in the manner described by Dr. Mark (AMER. NATURALIST, June, 1885).—*Wm. A. Locy.*

THE ROCKING MICROTOME.[1]—The Cambridge (Eng.) Scientific Instrument Company have just introduced a new type of microtome, in which the sliding movement of parts is replaced by a rotary one. The ribbon of sections falls by its own weight direct from the razor on to a sheet of paper. The instrument is simple in construction and is sold at the comparatively moderate price of $26.

The chief objection to this microtome is, that it is adapted to only one mode of section-cutting, namely, that of producing ribbons of sections imbedded in paraffine. It could not be used for

[1] Journ. Roy. Mic. Soc., June, 1885, p. 549.

cutting collodion sections, nor could it be conveniently employed in the Duval-Mason method, where the block of paraffine is col-



The Rocking Microtome.

lodionized before making each section. The position of the object is such that it can not be conveniently watched during the

process of cutting; and this appears to me to form another serious objection to the instrument.

The construction of the instrument is as follows: Two uprights are cast on the base plate of the instrument, and are provided with slots at the top, into which the razor is placed and clamped by two screws with milled heads.

The imbedded object is cemented with paraffine into a brass tube which fits tightly on to the end of a cast-iron lever. This tube can be made to slide backwards or forwards so as to bring the imbedded object near to the razor ready for adjusting. The cast-iron lever is pivoted at about three inches from the end of the tube. To the other end of this lever is attached a cord by which the motion is given and the object to be cut brought across the edge of the razor. The bearings of the pivot are V-shaped grooves which themselves form part of another pivoted system.

Immediately under the first pair of V's is another pair of inverted V's, which rest on a rod fixed to two uprights cast on the base plate. A horizontal arm projects at right angles to the plane of the two sets of V's, the whole being parts of the same casting. On the end of the horizontal arm is a boss with a hole in it, through which a screw passes freely. The bottom of the boss is turned out spherically, and into it fits a spherical nut working on the screw. The bottom of the screw rests on a pin fixed in the base plate.

It will be seen that the effect of turning the screw is to raise or lower the end of the horizontal arm, and therefore to move backwards or forwards the upper pair of V's, and with them the lever and object to be cut. The top of the screw is provided with a milled head, which may be used to adjust the object to the cutting distance.

The distance between the centers of the two pivoted systems is one inch, and the distance of the screw from the fixed rod is six and a quarter inches. The thread of the screw is twenty-five to the inch; thus if the screw is turned once round, the object to be cut will be moved forward $\frac{1}{25}$ of $\frac{1}{6\frac{1}{4}}$ or $\frac{1}{156}$ of an inch.

The turning of the screw is effected automatically as follows: A wheel with a milling on the edge is fixed to the bottom of the screw. An arm to which a pawl is attached rotates about the pin which supports the screw.

This arm is moved backwards and forwards by hand or by a cord attached to any convenient motor. When the arm is moved forward the pawl engages in the milling and turns the wheel; when the arm is moved back the pawl slips over the milling without turning the wheel. A stop acting against the pawl itself prevents any possibility of the wheel turning, by its own momentum, more than the required amount. The arm is always moved

backwards and forwards, between two stops, a definite amount, but the amount the wheel is turned is varied by an adjustable sector, which engages a pin fixed to the pawl and prevents the pawl from engaging the milling on the wheel. By adjusting the position of this sector the feed can be varied from nothing to about $\frac{5}{32}$ of a turn, and hence since the screw has twenty-five threads to the inch, the thickness of the sections cut can be varied from a minimum, depending on the perfection with which the razor is sharpened, to a maximum of $\frac{5}{32}$ of $\frac{1}{25}$ of $\frac{1}{6\frac{1}{4}}$ or $\frac{1}{1000}$ of a turn. The practical minimum thickness obtainable with a good razor is approximately $\frac{1}{40000}$ of an inch. The value of the teeth on the milled wheel are as follows:

1 tooth of the milled wheel = $\frac{1}{40000}$ of an inch = .000625mm
2 teeth " " " = $\frac{1}{20000}$ " " = .001250mm
4 " " " " = $\frac{1}{10000}$ " " = .0025mm
16 " " " " = $\frac{1}{2500}$ " " = .01mm

The movement of the lever which carries the embedded object is effected by a string attached to the end of the lever. This string passes under a pulley and is fastened to the arm carrying the pawl. Attached to the other end of the lever is a spring pulling downwards.

When the arm is moved forwards the feed takes place, the string is pulled, the embedded object is raised past the razor, and the string is stretched. When the arm is allowed to move back the spring draws the imbedded object across the edge of the razor, and the section is cut. The string is attached to the lever by a screw which allows the position of the embedded object to be adjusted so that, at the end of the forward stroke, it is only just past the edge of the razor. This is an important adjustment, as it causes the razor to commence the cut when the object is traveling slowly, and produces the most favorable conditions for the sections to adhere to each other.

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SCIENTIFIC NEWS.

— To the report of the Commissioner of Fisheries of New York in charge of the oyster investigation is appended Dr. H. J. Rice's excellent tract on the propagation and natural history of the American oyster. An account is first given of experiments carried on at Cold Spring harbor on the propagation of the oyster, and then follows notes on the distribution of the animal, the structure of its shell, the gross anatomy of the animal including the reproductive organs, succeeded by chapters on seed oysters, the food of the oyster, its coloration, its artificial propagation, the methods of obtaining spat, and the friends and enemies of the oyster. Reference is made to the supposed method of extraction

of the animal of the oyster by the star-fish; as the result of his own observations Dr. Rice was not able to decide as to the exact method or methods; he, however, inclines to the opinion that the star-fish works in more than one way, sometimes suffocating, sometimes poisoning and sometimes taking in the oyster bodily. Due credit is given to the labors of Dr. Brooks and Mr. Ryder. The report is illustrated by six plates, which add materially to our knowledge of the structure of the shell, the soft parts and the rate and mode of growth of the shell.

— An apiculture station has recently been established at Aurora, Ills., in connection with the Entomological division of the Department of Agriculture. Mr. Nelson W. McLain has been appointed to take charge of the station, and Professor Riley has instructed him to pay particular attention to the following subjects:

1st. To secure the introduction and domestication of such races of bees as are reported to possess desirable traits and characteristics; to test the claims of such races of bees as to excellence, and to prove by experiments their value to the apiculturists of the United States and their adaptation to our climate and honey-producing flora.

2d. To make experiments in the crossing and mingling of races already introduced, and such as may hereafter be imported, and by proper application of the laws of breeding endeavor to secure the type or types best adapted by habit and constitution to the uses of practical bee-keepers in the United States.

3d. To make experiments in the methods of artificial fertilization, and if possible demonstrate the best process by which the same may be accomplished.

4th. To test the various methods of preparing bees for winter —such as stimulating late breeding, removing the pollen from the hive in winter, feeding on sugar syrup, watering during long confinement, the stimulating of early breeding in spring, the control of the swarming impulse and the prevention of swarming.

5th. To gather statistics concerning the bee-keeping industry in the United States, and obtain an approximate estimate of the number of colonies of bees kept, the number of pounds of honey and wax produced in the several States and in the United States, and the value of the same.

6th. To make experiments with and observations concerning varieties of honey-producing plants for bee-forage.

7th. To study the true cause or causes of diseases yet imperfectly understood, and the best methods of preventing or curing such diseases.

8th. To obtain incontestible results by intelligent experiments, upon scientific methods, as to the capacity of bees, under exceptional circumstances, to injure fruit, *i. e.*, to set at rest the ever-discussed question of bees *vs.* fruit.

— We have received from the author, M. A. Vayssière, memoire No. 3 of the second volume, zoölogy, of the Annales du Musée d'Histoire Naturelle de Marseille, entitled Recherches zoologiques et anatomiques sur les Mollusques opisthobranches du Golfe de Marseilles, 5, première partie, Tectibranches. This work fills 181 quarto pages, with six well-drawn plates, and is a product of the zoölogical laboratory founded by Professor Marion at Marseilles.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—This body met at Ann Arbor, Mich., Wednesday August 26th, and terminated its sessions Tuesday September 1st, 1885, under the presidency of Professor H. A. Newton of New Haven. The officers of the meeting were as follows: Of Section E, vice president, Edw. Orton of Columbus, O.; secretary, H. Carvill Lewis of Philadelphia. Of Section F, Burt G. Wilder of Ithaca; secretary, J. A. Lintner of Albany. In the absence of Professor Wilder Professor T. J. Burrill of Champaign, Ill., took the chair. Of Section H, Wm. H. Dall of Washington, D. C.; secretary, Mrs. Erminnie A. Smith of Jersey City. In the absence of Mr. Dall, Mr. J. Owen Dorsey, of Washington, became chairman of the section. Section G was united with Section F. Its chairman was Mr. S. H. Gage of Ithaca; secretary W. H. Walmsley of Philadelphia.

The following papers were read:

Thursday, August 27th. *Section E—Geology.*—The geology of Ann Arbor, Alexander Winchell; Westward extension of rocks of the Lower Helderberg period in New York, S. G. Williams; Lower Silurian fossils in a limestone of Emmons' original Taconic, James D. Dana; Structure and relations of the Dakota Group, L. E. Hicks; Results from a study of the Gabbros and associated Amphibolites in Delaware, Frederick D. Chester; On the occurrence of trap rock in eastern Kentucky, A. R. Crandall; The quaternary deposits of Illinois, A. H. Worthen; Post-glacial changes of level in the basin of Lake Ontario, G. K. Gilbert; Sources of trend and *crustal surplusage* in mountain structure, Alexander Winchell; A probable cause of the shrinkage of the earth's crust, William B. Taylor.

Section F—Biology.—An observation on the hybridization and cross-fertilization of plants, E. Lewis Sturtevant; germination studies, E. Lewis Sturtevant; Biological deductions from a comparative study of the influence of cocaine and atropine on the organs of circulation, Dr. H. G. Berger; On the brain and auditory organs of a Permian Theromorph Saurian, Edw. D. Cope; Observations on the musk-rat, Amos. W. Butler; The question

of bisexuality in the pond-scums (Zygnemaceæ), Charles E. Bessey; The process in fertilization in *Campanula americana*, Charles R. Barnes; The structure of *Glottidea pyramidata* (Stim.) Dall, Dr. H. G. Berger; Cœnostroma and Idiostroma, and the comprehensive character of the Stromatoporoids, Alexander Windell; The song-notes of the periodical Cicada (*Cicada septendecim L.*), and the mechanism by which they are produced, C. V. Riley; The periodical Cicada in Southeastern Indiana, Amos W. Butler; Some popular fallacies and some new facts regarding *Cicada septendecim*, C. V. Riley; Proof that Bacteria are the direct cause of the disease in trees known as pear-blight, J. C. Arthur.

Section G—Histology and Microscopy.—Photo-micrographs on gelatine plates for lantern projection, W. H. Walmsley; Photo-Micrography work with high powers, Professor T. J. Burrill; A new, cheap, useful and quickly constructed adjustable microtome, Chas. Porter Hart; Optical arrangements for Photo-micrography, and remarks on magnification, Romyn Hitchcock.

Section H—Anthropology.—A visit to the Siletz Agency, Rev. J. Owen Dorsey; Permanence of early Iroquois Clans and Sachemships, Rev. W. M. Beauchamp; The remains at San Juan Teotihuacan, Amos W. Butler; Significance of Flora to the Iroquois, Mrs. Erminnie A. Smith; A supposed natural alloy of copper and silver from the north shore of Lake Superior, in Minnesota, N. H. Winchell; Exhibition of copper implements, W. C. Wyman.

Friday, August 28th. *Section E—Geology and Geography*—On the Classification of the upper Devonian, Henry S. Williams; The Gas and Oil Wells of Northwestern Ohio, Edward Orton; The Loess and Drift-clays, Wm. McAdams; Discovery of fossiliferous Potsdam Limestone, at Poughkeepsie, N. Y., William B. Dwight.

Section F—Biology.—On the parasites of the Hessian fly (*Cecidomyia destructor* Say), C. V. Riley; The mechanical injury to trees by cold, T. J. Burrill; Aquatic respiration in soft-shelled turtles (Aspidonectes and Amyda); A contribution to the physiology of respiration in vertebrates, Simon H. Gage and S. S. Phelps Gage; The presence or absence of underbasals in crinoids can be ascertained from the columns, Charles Wachsmuth; Further observations on the adventitious inflorescence of *Cuscuta glomerata*, Charles E. Bessey; On the phylogeny of the placental mammalia, Edward D. Cope; The structure of *Glottidea pyramidata* (Stim.) Dall, Dr. H. G. Beyer.

Section H—Anthropology.—Sacred war tent and some war customs of the Omahas, Alice C. Fletcher; Laws and terms of relationship of the Omahas, Francis LaFlesche; Exploration of recent Indian mounds in Dakota, William McAdams; Burial customs of our aborigines, Henry Gillman; Ancient pictographs

in Illinois and Missouri, William McAdams; Exhibit of specimens with notes, W. L. Coffinberry; Customs, language, and legends of the Senecas, J. W. Sanborn.

Monday, August 31st. *Section E—Geology and Geography.*—A new mass of meteoric iron from Charleston, Kanawha Co., West Virginia, George F. Kunz; Mineralogical notes: curious form of beryl from Auburn, Maine, capped garnet from Raymond, Maine, and an artificially stained turquoise from New Mexico, George F. Kunz; The tourmaline locality at Rumford, Oxford Co., Maine, George F. Kunz; A pseudomorph of feldspar after leucite (?) from Magnet Cove, Arkansas, George F. Kunz; Notes on a remarkable collection of rough diamonds, George F. Kunz; Native antimony and its associations at Prince William, York Co., N. B., George F. Kunz; The record of the deep well of the Cleveland Rolling Mill Company, Cleveland, Ohio, Edward Orton; The materials of the Appalachians, E. W. Claypole; Apatite deposits in Laurentian rocks, T. Sterry Hunt; Glaciation of the Lackawanna valley, John C. Branner.

Section F—Biology.—On the appearance of the relation of ovary and perianth in the development of dicotyledons, John M. Coulter; A new membrane of the human skin, Charles Sedgwick Minot; The development of the prothallium of ferns, D. H. Campbell; Organization and death, Charles Sedgwick Minot; Morphology of the supra-renal capsules, Charles Sedgwick Minot; The importance of individual facts of environment in the formation of groups of animals, J. B. Steere; Experiments antagonizing the view that the serrulæ (serrated appendages) of Amia are accessory organs, Burt G. Wilder; The structure of the human placenta, Charles Sedgwick Minot; On the structure and functions of Sphæridia of the Echinidæ, Howard Ayers; On the carapax and sternum of the decapod Crustacea, Howard Ayers; Notes on some injurious fungi of California, W. G. Farlow; A new Chromogenous Bacillus (*Bacillus luteus suis*), D. E. Salmon and Thomas Smith; Evolution of the lungs, Charles Sedgwick Minot.

Section H—Anthropology.—Music in speech, M. L. Rouse; The stone ax in the Champlain valley, G. H. Perkins; The number habit, C. S. Minot; Indian personal names, J. Owen Dorsey; An average day in camp, Alice C. Fletcher; Are contemporary phantasms of the dead to be explained partly as folk lore? C. S. Minot; Ornaments made of pieces of human skulls, from a mound in Ohio, F. W. Putnam.

Tuesday, September 1st. *Section E—Geology and Geography.*—The Corniferous or Upper Helderberg group of Scott county, Iowa, and Rock Island, Ill., with a list of its fossils, A. S. Tiffany; The Chemung group at Burlington, Iowa, with a list of its fossils, A. S. Tiffany; Notice of Lingula and Paradoxides from

the red quartzites of Minnesota, M. H. Winchell; On the occurrence of trap-rock in eastern Kentucky, A. R. Crandall; Glaciation of the Lackawanna valley, John C. Branner.

Section F—Biology.—The structure of the human placenta, Charles Sedgwick Minot; Notes on some injurious fungi of California, W. G. Farlow; Evolution of the lungs, Charles Sedgwick Minot.

Section H—Anthropology.—Extracts from the address of the vice-president; "The Native Tribes of Alaska," W. H. Dall; On certain singular stone implements from Vermont, G. H. Perkins; Explorations in the great Cahokia mounds, Wm. McAdams; Proper methods of exploring mounds, etc., F. W. Putnam; Who made belt wampum? with exhibits, Erminnie A. Smith; Primary classifiers in Dhegiha and cognate languages, J. Owen Dorsey; Exhibition of copper implements, W. C. Wyman; The Degeneracy of Races, Wm. Zimmerman; The Animal Mounds of Wisconsin, W. DeHass; Archæological Remarks, W. DeHass.

The place of meeting for 1886 was decided to be Buffalo, New York.

The following officers were elected for the year 1886: President, E. S. Morse, of Salem, Mass.; vice-presidents, A—Mathematics and astronomy, J. W. Gibbs, of New Haven, Conn.; B—Physics, C. F. Brackett, of Princeton, N. J.; C—Chemistry, H. W. Wiley, of Washington, D. C.; D—Mechanical science, O. Chanute, of Kansas City, Mo.; E—Geology and geography, T. C. Chamberlin, of Washington, D. C.; F—Biology, H. P. Bowditch, of Boston, Mass.; H—Anthropology, Horatio Hale, of Clinton, Ont.; I—Economic science and statistics, Joseph Cummings, of Evanston, Ill.; permanent secretary, F. W. Putnam, of Cambridge. Mass. (holding over); general secretary, S G. Williams, of Ithaca, N. Y.; assistant general secretary, W. H. Pettee, of Ann Arbor, Mich.; secretaries of the sections, A—Mathematics and astronomy, S C. Chandler, of Cambridge, Mass.; B—Physics, H. S. Carhart, of Evanston, Ill.; C—Chemistry, Wm. McMurtrie, of Champaign, Ill.; D—Mechanical science, William Kent, of Jersey City, N. J.; E—Geology and geography, E. W. Claypole, of Akron, Ohio; F—Biology, J. C. Arthur, of Geneva, N. Y.; H—Anthropology, A. W. Butler, of Brookville, Ind.; I—Economic science and statistics, H. E. Alvord, of Mountainville, N. Y.; treasurer, William Lilly, of Mauch Chunk, Pa.

THE

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EXAMPLES OF ICONOCLASM BY THE CONQUERORS OF MEXICO.

BY W. H. HOLMES.

THE two great centers of aboriginal American culture, Mexico and Peru, were the first to feel the shock of the conquest, and the native peoples, together with their arts and institutions, sank at once into irretrievable ruin. Temples, sculptures and paintings, the tangible representatives of an idolatrous worship, excited the hatred of a fanatical priesthood, and were, as nearly as possible, swept from the face of the land. The fiercely intolerant spirit of the representatives of the church is well illustrated by the language of a letter written by Zumarraga, the chief inquisitor of Mexico, to the Franciscan chapter at Tolosa, in January, 1531. The words are as follows: "Very reverend Father be it known to you that we are very busy in the work of converting the heathen; of whom, by the grace of God, upwards of one million have been baptized at the hands of the brethren of the order of our Seraphic Father, Saint Francis; five hundred temples have been leveled to the ground, and more than twenty thousand figures of the devils they worshiped have been broken to pieces and burned."[1]

There was, however, a limit to the power of destruction. Many of the greater monuments have defied the destroyer and stand to-day and will stand for ages to come as illustrations of the power and culture of their builders. There were probably few works more difficult to destroy or wholly deface than those found

[1] Quoted by Bancroft, Native Races, Vol. II, p. 171.

upon the summit of the justly famed hill of Texcocingo, a favorite resort of the most enlightened rulers of Texcoco.

This *cerro* is upwards of 600 feet in height, and is a narrow ridge, nearly a mile in length, that projects into the valley of Mexico from the range forming its eastern rim. From Texcoco it assumes a somewhat conical shape as indicated in the accompanying sketch, Fig. 1. The upper part is very steep, exhibiting cliffs and huge detached masses of a coarse pinkish-gray moderately hard rock, usually called porphyry, that proves, upon examination under the microscope, to be a variety of andesite. This hill has been the witness of many important and thrilling events in pre-Spanish as well as in Spanish times. It gives unmistakable evidence of having been at one time literally covered

FIG. 1.—Hill of Texcocingo from Texcoco.

with artificial structures, and numerous recesses, niches, stairways and cisterns have been hewn in the living rock. It was a sad day to the despairing Texcocan when he saw his deities tossed over the cliffs, his shrines desecrated, and at the same time beheld afar off, across the plain, the smoke rising from the burning of his sacred records.

At the present time this wonderful hill is almost denuded of its artificial features. There remain but traces of walls and floors, the deep recesses cut in the solid rock and the great battered boulders that were once the images of gods, to tell imperfectly the story of a blasted culture.

Among the most interesting of these remnants is a recess a short distance below the summit on the side facing Texcoco, and indicated by the middle cross in the accompanying sketch. It still retains evidences of its original character and functions. In

the first place it must be described in detail. In beginning an edifice or apartment on the face of the hill, it was necessary first to prepare a floor by cutting a niche into the rock and filling out the level with masonry and cement[1] until a proper platform was secured. The back wall was formed entirely of the living rock and afforded the opportunity of carving out the deity who was to preside over the place. The side walls are partially of the rock in place, and were completed by the addition of heavy masonry, portions of which are still to be seen.

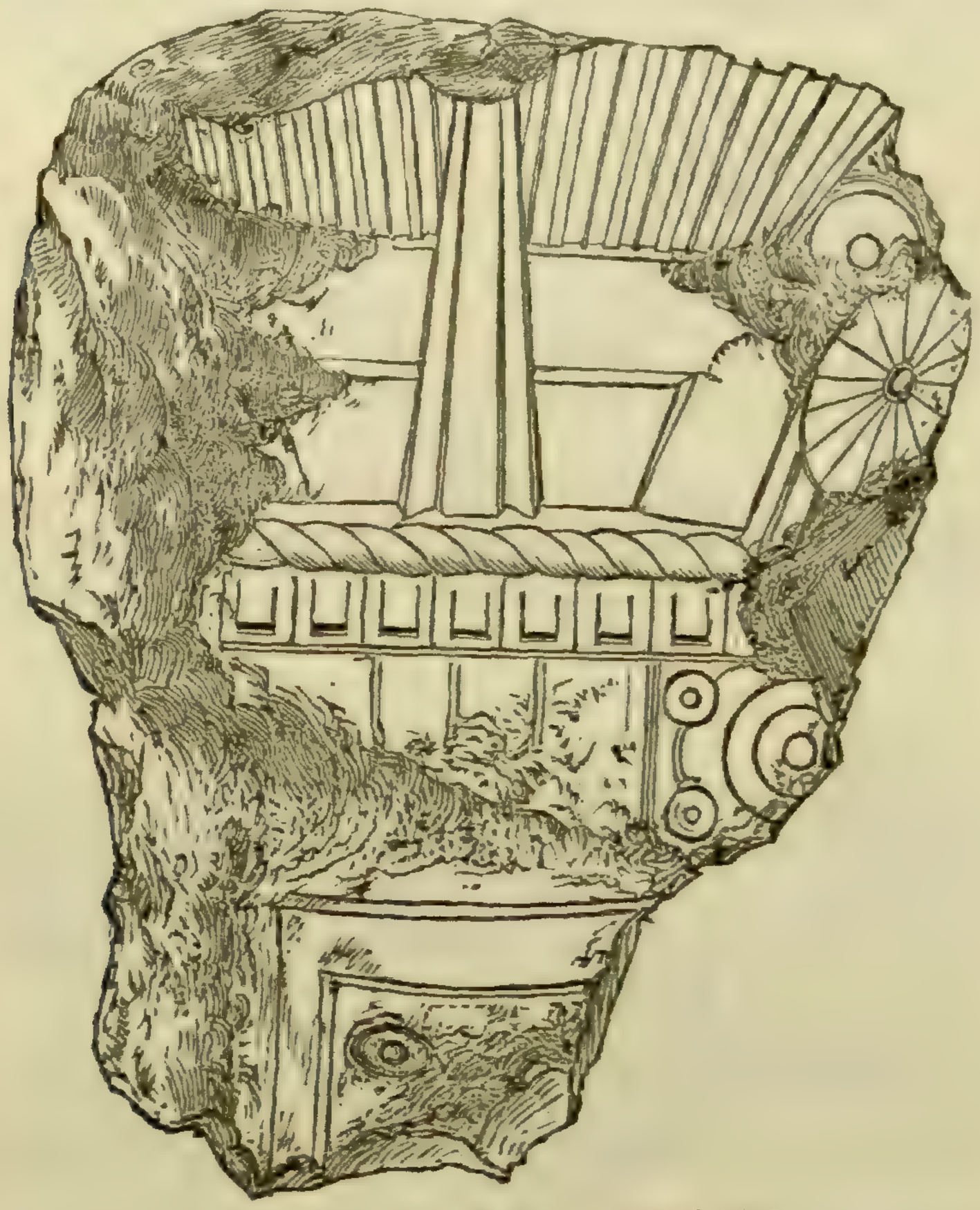

FIG. 2.—Sketch of fragment of idol.

On the floor of this recess I came upon a large fragment of rock that exhibited evidence of having been elaborately sculptured, and which at first suggested the figures peculiar to the calendar stones of the museum at Mexico. The fragment is nearly four feet long, by about three wide and half that thick. The sculpture is confined to one face, the sides and back showing rather fresh irregular fracture.

In making a sketch of the block I observed first that the figures were not symmetrically arranged and not truly radiate, and

[1] A common lime-sand cement, as determined by Professor F. W. Clark.

that a number of the features resembled the ornaments and trappings characteristic of the head-dresses commonly seen in Aztec sculpture. This led to the search for other features, and finally to the discovery of a partially obliterated eye toward the smaller end of the fragment. This convinced me that the object was part of the head of a huge idol. My sketch is reproduced in Fig. 2, but gives a very imperfect idea of the work, which in precision of execution and delicacy of finish equals anything of its class yet brought to my notice. It is a remarkable fact that the surface of the carving has been finished with a coat of red paint or enamel, which to this day exhibits a high polish, and is so

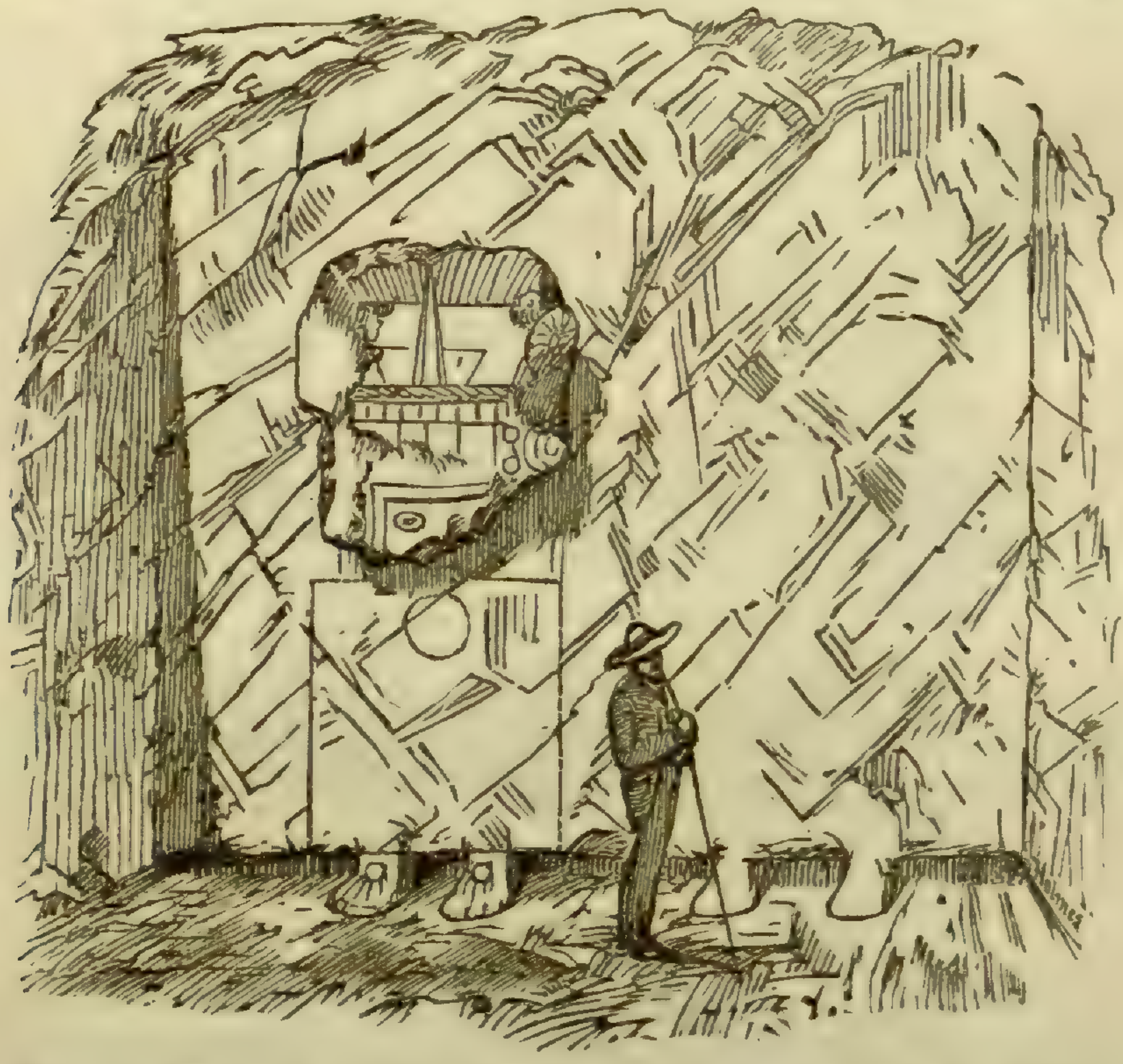

FIG. 3.—Probable position of the idol at the back of the niche.

firmly attached to the rock surface as to be removed with the greatest difficulty. The other portions of the figure have been broken up and carried away, or have been rolled down the side of the *cerro*. At first I was at a loss to imagine the original character and position of the figure to which the head belonged, but after a careful study of the recess I came to the conclusion that it had originally occupied the back wall of the recess, and that it had been carved from the rock in place. The proof of this was entirely satisfactory.

I observed first that the central part of the rear wall was not smoothly dressed, and that the rock surface showed compara-

tively recent fracture. In examining it closely I found at the base, as shown in the sketch, Fig. 3, an undercut channel, in and in front of which, after clearing away the earth, I detected a pair of feet carved in the rock. They were badly mutilated but still showed traces of the toes and portions of the sandals. These feet had originally formed part of a complete figure, and the fragment of head found on the floor had belonged to it.

Another pair of feet at the right, still more completely obliterated, indicated the position of a second figure. The fragment shown in Fig. 2 lies on the floor at *a*, Fig. 3, and doubtless originally occupied nearly the position in the wall indicated in the sketch. These figures had been wedged or blown off and broken up by the Spaniards, and the whole shrine dismantled. There are other recesses of similar character in this hill, which show like treatment by the conquerors or their descendants. One at the opposite end of the crest, near the terminus of the great causeway, is said to have had a calendar carved in the living rock of the rear wall, a spot now exhibiting a deep irregular excavation thought to have been made by treasure hunters.[1]

In this connection it is convenient to mention a remarkable piece of work, a block of curiously carved andesite that rests upon the outer extremity of the crest of the hill. Although in such a prominent place it is partially obscured by trees of copal, etc., and would escape the attention of the casual observer; besides, the sledge of the destroyer has obliterated much of the evidence of art. In order to preserve a memorandum of the work, I stood upon a contiguous rock and made the sketch presented in Fig. 4, my line of vision being at an angle of 45° with the flat surface of the stone, *c c*, which is horizontally placed.

The surface has been cut down, leveled and finished with a pointed implement, leaving a pecked or granular surface, while the middle portion of the rock was left in relief and carved into the curious form indicated in the sketch, but which has been almost completely obliterated by the hammer of the despoiler.

The query arises, what has this rock been, and what its function, that the godly missionaries should have endeavored to destroy it?

[1] For details see Bancroft's Native Races and works cited by him.

I was struck at first sight, although without previous thought of the matter, that here was a stone perfectly suited for the offering of human sacrifice. I could readily imagine the feet of the victim placed upon the step *b*, while his back rested upon the highest level, *a*, giving the ideal position assumed in the pictures in the blood-curdling narratives of the conquerors. The level spaces, *c c*, would afford a perfectly convenient support for the feet of the officiating priests.

By inverting the picture it will be seen that the part of the figure most effectually destroyed by the hammer of the iconoclast has an outline suggestive of the upper part of a human figure, so

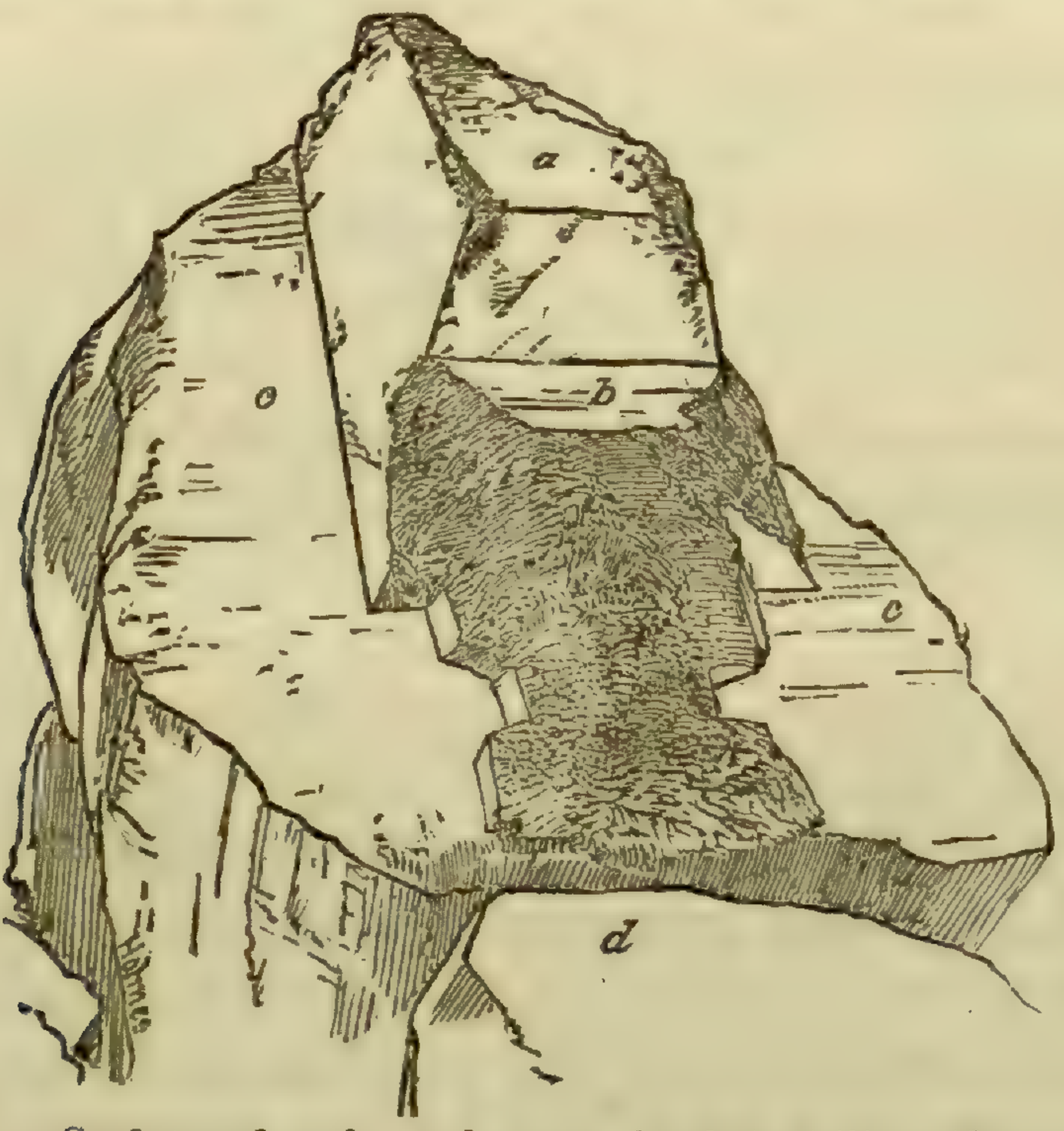

FIG. 4.—Sculptured rock on the summit of the hill of Texcocingo.

that it is not impossible that this stone was really the figure of some deity, partly finished, perhaps, as the step-like portion representing the knees of the supposed figure is entirely without suggestions of the limbs.

The prostrate position rather tends to discredit this theory, as such figures are usually carved in place, the mass being too great to be easily adjusted to an upright position. The length of this figure and of the block is about eleven feet. A contiguous block of stone, *d*, although apparently never a part of it, is also cut down to the same level as *c c*, indicating the intention to make use of the surface in its present position. It is perfectly natural that one should feel a desire to identify one of the sacri-

ficial stones of the Aztecs. I present this instance as at least a plausible case.

The Texcocan monarch is said to have climbed the 500 steps that led to the summit to worship an idol that stood there, and it is said that this idol, hewn from the living rock, was the image of a coyote, the emblem of Nezahualcoyotl, the King.

Since, however, human sacrifice is acknowledged to have been extensively practiced by these people, it strikes me that in no other locality could we more readily expect to find the material evidence of the existence of such a practice as on the summit of this wonderful hill, a point which overlooked the whole valley of Mexico, and which seems to have been almost wholly devoted to the service of the gods.

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THE PRESENT CONDITION OF THE YELLOWSTONE NATIONAL PARK.

BY E. D. COPE.

TIME has fully justified the enterprise of Dr. Hayden in urging upon Congress the project of the creation of the Yellowstone National Park; and the protection of this and other especially interesting parts of our country by the arm of the National Government has met with almost unanimous approval.

The function of the Yellowstone Park may be looked on as three-fold: first, as a place of permanent preservation of the geysers and hot springs and their deposits; second, as a place of protection of the game of the country; and third, as a place of recreation for tourists. The first of these uses has always been uppermost. The second has been more and more engaging the attention of Congress, and the NATURALIST published an editorial in its issue of July, 1884, pressing on public attention the necessity of making it a more complete preserve for game than it had previously been. This article was reprinted; and later, our contemporary, *Science*, took up the subject editorially. As a probable consequence of this agitation a bill was introduced into Congress, last winter, providing for a more complete supervision of the territory of the park. Ten men with a gamekeeper and the superintendent, constitute the present force. As this was manifestly insufficient to police a territory of such great extent, the new bill contemplated the addition of fifteen men to the num-

ber, thus increasing the police to twenty-five men. Their salaries were fixed by the new bill at $1500 per annum. The sum now paid is $900, from which the men are expected to feed themselves, an important consideration in so expensive a region. This bill was not passed.

Since the attention of Congress and of the press has been directed to the park, the protection of its beauties and curiosities has been more efficient. A number of persons have been fined for breaking the geyser deposits, including at least one member of Congress. In this respect the protection may be considered to be now fairly good. Protection of game has been less successful because more difficult, and because of the great inadequacy of the force. Bison, elk, moose, deer, etc., are far less abundant than when the park was first created. The bison have been, I am informed, reduced to a herd of about sixty individuals, and the elk have been decimated. The moose are confined to a small region. From the inaccessible nature of their habitat, mountain sheep have not been so reduced in numbers. Protection has, however, become more definite in this direction. During the past year several persons have been fined from $75 to $100, and one old hunter, who defied the guards, was caught, fined $100, and imprisoned for six months.

These measures of protection can, however, only be carried into effect by an increase in the force and their proper distribution throughout the territory. Persons may now hunt undetected in the park, and may drive game outside of its boundaries without difficulty and kill it. The disposition to kill is not controlled by any considerations of decency in some men. Thus a party of English shooters killed, for their amusement, twenty or thirty from the bison herd without taking any part of the animals for their use, thus reducing their numbers by one-fourth at least, at one battue. Some persons state that protection is useless because the game leaves the park in winter. This I ascertained is not true, for there are numerous well-protected localities where the game winter safely.

The bill which was brought before Congress last winter for the more efficient protection of the park should be passed by the Congress of 1885–6, with some possible amendments. Thus the force should be increased to twenty-five men, each with a salary of $1000 per annum exclusive of his food and boarding. The

park should be divided into twenty-five parts, each one supervised by one of the guards with perhaps an assistant or roustabout. A simple house for the guard should be erected in each one of the divisions, and the guard should reside there through both winter and summer, and not be permitted, as is now the case, to come into the settlements and remain there during the winter. It is well known that large game may be more readily destroyed in winter than in summer. Those guards whose districts include the geysers will naturally be more occupied with the protection of these objects than the protection of the game, as the one is generally abundant inversely to the other. Visitors should not be permitted to carry guns or other hunting apparatus through the park, and should be required to deposit them with some designated person to be held during their stay in it.

A project for reducing the size of the park has already been introduced into Congress. This is in order to permit the construction of a railroad to the Clark's Fork mining camp, through the park via the Yellowstone, the East Fork, and Soda Butte creek. As the law creating the park forbids the passage of railroads through it, it is sought to alienate a tract of land from the park, of a triangular shape, of about forty miles in length and twelve to fifteen miles wide at the widest part. An examination of the map will show that the direct route from the Clark's Fork mines to the Northern Pacific railroad is not more than *one-tenth* as long as the one proposed to pass through the park, so that it is difficult to guess at the motive which prompts the proposition in view. The project should be subjected to the most rigid examination, as any alienation of the territory of the park seems to be unnecessary. On the other hand much greater security as a game preserve would be accomplished if the region on the south-east border of the park, which includes the Hoodoo mountains, were annexed to it. It is the headquarters of the game of the country, and that of the park frequently resorts to it. It is excessively rugged, and is nearly useless to man for any other purpose.

As regards the entertainment of tourists, the administration of the new superintendent, Mr. Weare, has been a great improvement over that of his predecessor. The monopoly of transportation, sought to be established, has been abolished, and competition is free to guides and hotel-keepers. This naturally has the

effect of reducing rates, and will do so still more, for the charges have not yet reached bed-rock. When this desirable result has been achieved, the Yellowstone National Park will become one of the most popular resorts for tourists of all nations, who will be amply repaid by an inspection of one of the few remaining regions of the earth where thermal activity still reaches its surface, and of the grand and impressive scenery which surrounds it.

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AN OBSERVATION ON THE HYBRIDIZATION AND CROSS-BREEDING OF PLANTS.[1]

BY E. LEWIS STURTEVANT, M.D.

GEORG von Martens, in his Gartenbohnen, Ravensburg, 1869, p. 35, under Phaseolus Pardus virescens, the graugrune pantherbohne, says: "I was very much surprised to obtain not less than eight varieties of beans, die incarnatbohne, die dottergelbebohne, die weissebohne, die amethystfarbige zebrabohne, die graugrune pantherbohne, die helle pantherbohne, die gelbgefleckte pantherbohne, and the princessinbohne. With more thorough investigation I decided that the zebrabohne was most likely a neighbor which had overrun the bed, but all the others came from the bed, and some, the incarnatbohne and the weissebohne had not been planted in the whole garden." Martens might have expressed surprise that these varieties from the seed of the graugrune pantherbohne were all towards named varieties rather than sports or intermediates, but this fact, which frequently appears noted in his book, does not receive attention as being of any importance.

At the New York Agricultural Experiment Station, in 1882, a few oblong beans, slightly flattened sidewise and mottled in two shades of brown, were selected from the yield of the golden cranberry. This selection, planted by itself in 1883, gave eleven distinct forms, many of which can be referred to named varieties, and possibly with a greater acquaintance with varieties all might be so referred; an illustration confirmatory of the results above noted by Martens, and is strengthened by a list of similar occurrences with other varieties in 1883 numbering a score.

This fact of named varieties being produced from seed of other varieties is not confined to the bean family alone. The following

[1] Read before section F, A. A. A. S. at the Ann Arbor meeting.

list includes similar occurrences noted at the New York Agricultural Experiment Station during the last three years:

Maize.—Seed of one kind sown often produces samples of other kinds of corn in the crop, and these varieties can usually be distinctly referred by name to varieties with which the original seed might have been crossed. Purposely hybridized seed has produced the original parentage without intermediate types, and seed exposed to hybridization during two years with many sorts of corn, has yielded ears of the types of corn with which cross-breeding or hybridization has been effected, without appearance of intermediate forms.

Barley.—April, 1884, one head of cross-bred awnless barley was received from Mr. Horsford, a seed-grower in Vermont. The yield of the twenty-six seed was four distinct sorts of barley; one beardless black, one beardless white, one bearded black and one bearded white. One peculiarity was, that the beardless forms could be referred to *Hordeum trifurcatum.* There were no intermediates in this crop.

Peppers.—In 1882 eleven varieties of peppers were grown; in 1883, nineteen varieties. The pepper plant is extremely variable. The fruit on different plants of the same variety often varies much in shape; on some the fruit is borne erect, on others pendant; certain plants of a variety often mature their fruit much earlier than do others. These facts, as well as direct observation, certify to the ready cross-fertilization between varieties. Yet despite this apparent cross-fertilization, varieties by selection are kept true to name, and almost all or perhaps all of the various "sporting" forms noted by us are found illustrated in Hortus Eystettensis, 1613, a fact which brings the pepper in line with our other illustrations.

Tomato.[1]—In 1882 the French upright tomato was crossed with

[1] Some additional observations of a later date than those given in this paper are as follows:

Melon.—The Christiana melon seed used in 1885 was from two sources. The one seed pure and the crop all on type; the other seed station-grown in 1883 and subjected to a possible cross-fertilization with other varieties; the produce from this seed gave this year fruit mostly of pure Christiana type, but some plants yielded fruit of the early white Japan, long Persian and Hackensack types, and no intermediates. These off-varieties were among the melon varieties of 1883, and by which there was a possibility of the Christiana being crossed through insect agency.

Tomato.—In 1883 the French upright tomato was crossed by the Livingston's favorite, and the crossed seed has been attempted to be grown in purity up to date.

pollen from the alpha and Livingston's favorite. The produce from the cross-breds was one plant of the French upright, a hundred or more of the common form, and no intermediates. The fruit was all clustered, however, and of one type of bearing. The types of the tomato fruit have not as yet been sufficiently studied by us to allow of a judgment upon variability in this respect.

Squash. — In 1883 the perfect gem and vegetable marrow squashes were crossed in both directions. The seed planted in 1884 gave good types of the cocoanut, green-striped bergen and the courge d'Italie varieties. In 1883, the year the seed was saved, we had no plants of these varieties upon the station grounds. There were also some unknown forms, but none that could be called strictly intermediate between the varieties, and some which represented each parentage.

Lettuce.—In 1883 the green fringed and the deer tongue lettuce was crossed. In 1884 the crop yielded forms which could be referred to the Batavian, Silesian and Malta drumhead varieties,

This year is hence the second generation from the cross. The number of plants under observation have been numerous, occupying three-twentieths of an acre. The types of the plants are French upright and the common, without intermediate forms. The types of the fruit are French upright, Livingston's favorite, common red and great Chihuahua, and no intermediates that can be recognized. The last-named is precisely on type both in plant and fruit, but few plants as compared with the others.

French upright crossed by acme. First generation. The types of plant either French upright or acme. The fruit acme, French upright and common red, and no intermediates.

French upright crossed by alpha. Second generation. The type of plant both kinds. The French upright type of plants have all French upright type of fruit. The common type of plants bear fruit of the fig, pear, plum, alpha, common red, French upright and great Chihuahua type, and no intermediates that can be recognized.

Currant crossed by Livingston's favorite. First generation. The types of plant mostly the currant, but some few plants of the common form, but slightly more upright. The fruit is racemed like the currant, but of far larger size, about 1 1/8 inch in diameter. Although I have never seen fruit of this character before, yet the plant and the fruit correspond very closely with the description of the Solanum racemosum cerasorum forma of Bauhin's Prodromus, ed. of 1671, p. 90; and we may legitimately suspect atavism has reproduced this apparently lost variety.

Turks cap crossed by several large varieties in 1882, such as acme, trophy, mayflower and paragon. The first generation was grown in the greenhouse, and hence the crop of 1885 is the fourth generation, the selections having been made each year for soundness and smoothness of fruit. The foliage of the 1885 plants somewhat variable but of the common type. The fruit can be referred to the apple, acme and common red. One plat from the earliest seed of this class has given constant foliage, and the fruit small, of the plum variety type, and of constant form.

and there were no intermediates between the parents. In this case we had the parents of two very distinct types, there being scarcely a point of resemblance in general appearance.

Pea.—In 1883 we had crosses between the sugar pea and the common pea. The 1884 crop from the crossed seed had the seed all of the sugar pea type, the pods all of the common type. The wrinkled pea crossed with the smooth pea gave wrinkled and smooth peas in the same pod, but no merging of the two forms.

These facts of careful observation and record are only explainable by the hypothesis that in certain kinds of cross-fertilizations and hybridizations the tendency of the crossed seed is to reproduce ancestral forms rather than intermediate forms. That there can be a blending of characters in certain cases is well known or certainly well asserted; but in the experience gained at the New York Agricultural Experiment Station, "sports" or blendings are rare in exact accordance with our familiarity with varieties. Thus in the case of the maize, at first we had many cases noted in our collection as variables; with the increase of varieties grown, and with increased specimens in our museum collection, these variables, almost without exception, could be referred to types or varieties, and the few exceptions to this statement occur in the little-studied class of pod or husk corns. Two illustrations will suffice: in New Jersey an excellent farmer there noticed a few pod ears in his crop of Blount's prolific dent and forwarded samples to the station as novelties. The seed from these pod ears reproduced with us Blount's prolific of perfect type and pod corn of the same type of ear which furnished the seed, and no variables from the two types noted. From the crossing of pod corn with sweet corn a new variety of sweet corn was produced, of a distinct type and esteemed by us a novelty in every respect, the cob being fusiform, the kernels horse tooth and much wrinkled, the stalk very small. At a later date this type appeared in our collections as the banana sugar, and was proven not to be original with us.

Darwin, in his Animals and Plants under Domestication, the New York edition of 1868, Vol. II, p. 54, has a section entitled, "Crossing as a direct cause of Reversion," and says: "But that the act of crossing in itself gives an impulse toward reversion, as shown by the reäppearance of long-lost characters, has never, I believe, been hitherto proved." His line of evidence, however,

is different from that here presented, and embraces a different series of observations.

The lack of agricultural museums in which domesticated varieties of plants find representation, the general ignorance of the varieties which were grown by our predecessors, and the in general careless descriptions which occur in the writings on agriculture, render a study of this sort embarrassing and difficult. A careful study, however, of the figures given by the botanists of the sixteenth century and thereafter, and a careful collation of evidence gleaned from more recent authors on gardening, together with the fact that the appearance of new form-species of cultivated vegetables seems to date from the introduction of forms of the same species from distant regions, and the rarity of appearance of novelties which cannot be identified with some previously described type,[1] all encourage to the belief in the correctness of the generalization that in our domesticated vegetable plants cross-fertilization shows its effect at once in the reproduction of the form-species and varieties which are involved in the parentage of the crossed seed, and that when "pure seed" is crossed intermediate forms rarely occur, but the original parents in variable proportions.

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OBSERVATIONS ON THE MUSKRAT.[2]

BY AMOS W. BUTLER.

THE muskrat (*Fiber zibethicus* Cuv.) is very abundant in most localities in Southeastern Indiana. In local distribution it varies in numbers according to the abundance of water and favorable localities for its increase. From all that I can learn, I do not think it is less common than at the time of the early settlement of this region.

These animals soon became acquainted with man and, from experience, learned that his presence assured them a great abundance of food at much less labor than formerly, while, at the same time, their natural enemies decreased in numbers on account of his necessity and pleasure. In some localities, owing to the perse-

[1] For instance, the deer tongue lettuce, with lanceolate leaves, which appeared about 1883, is almost identical with the Lactuca folio oblongo acuto figured in Bauhin's Prodromas, edition of 1671, p. 60.

[2] Read before the section of Biology of the American Association for the Advancement of Science at Ann Arbor, Mich., Aug. 27, 1885.

cution of a neighborhood of farmers, muskrats are few in numbers and are very shy. In the greater number of places, however, but little attention is paid to their destruction, and in consequence they become very tame, being found within the corporate limits of some of our larger towns. Originally they had their home in the neighborhood of natural water-courses, but with the system of State improvements which led to the building of our canals, there came, in many localities, a change in the life of the muskrats. Upon the completion of "The White Water Valley Canal," in 1846, the greater number of muskrats living upon the streams along which it ran, sought this artificial water-way and there established homes. No doubt they soon realized the greater security this canal afforded them from the frequent floods and from other dangers they had formerly experienced. At the present time, along that portion of the canal in existence, but few muskrats have sought the neighboring streams whence their ancestors came. When the muskrats changed their residence to the line of the canal they made new homes in its loamy banks, similar to the ones they had deserted along the river side. They are found both in our water-power canal and in the swifter streams, most numerous where there is a good food supply and at the same time near by a quiet nook secluded from the prying eyes of some human enemy and his allies. I have noticed them to be exceedingly abundant about the estuaries of creeks whose banks are covered with a luxuriant growth of vegetation.

When the canal through this part of the State was destroyed in 1866, the rats disappeared from many places where they had long found a home. Some sought the river where their ancestors had dug their holes in times long past; others gathered into certain parts of the old canal bed which were not permitted to remain unused. One of these portions is now the property of "The Brookville and Metamora Hydraulic Company," and is used for the purpose of supplying power to several mills along its banks. This part of the old canal is about fifteen miles long, extending from Laurel to Brookville. It is here that I have become best acquainted with this water-loving rodent.

The muskrat prefers its home in banks of loam or light clay, especially when heavily covered by vegetation. It is very exceptional that it occupies gravelly or sandy banks. Advantage has been taken of this fact by the managers of our water-way and

by the railroad company. Where they have constructed gravel banks and kept them free from vegetable growth, it is rarely they are bothered. Trenching the banks and filling in the trenches with gravel has proved of considerable value, while some protection has been afforded by a top-dressing of coarse gravel over an old bank of loam, provided vegetation is not allowed to grow thereon. When these precautions have not been taken, great damage is done each year; the burrows of these animals are continually being enlarged, and caving in, cause a leak, or undermine the railroad track, as the case may be.

In early spring the greatest damage is done. With the alternate freezing and thawing at that time of the year, the coverings of these underground passages drop in, exposing cavities of surprising extent to one who does not know the amount of subterranean work this animal is capable of doing. It requires vigilant work of eyes and ears to prevent this caving causing great damage to property. The underground homes of the muskrat in the banks of the canal have each two openings. When the water is at its usual stage an opening may be found, the upper edge of which is on a level with the surface of the water; another hole may be seen at low-water mark, the top of which is just level with the surface of the water at that stage. These holes are generally from eighteen inches to two feet apart. The passages from these openings lead backward and upward in a very crooked way, as any one who has attempted to follow them up can testify. These passages end in a large gallery which is the home of the animal. From this chamber a small passage leads to the surface, ending amid a bunch of grass or weeds. By this means the gallery is ventilated. The holes at the surface are known as "air holes." They are not always found, at least I have not in all instances observed them. In heavy ground an "air hole" is always found, while in porous ground it is as often absent as not. These underground burrows extend into the bank a distance of ten to twenty feet in a straight line, as a rule. Instances have been noted where the depth reached was less than the minimum given above, but such are rare. In localities along small streams which are subject to sudden rises, the distance attained occasionally reaches thirty feet, but in all instances the depth to which these burrows reach depends, in a great measure, upon the size and composition of a bank as well as upon the liability of the neighboring stream to sudden changes of level.

In the abandoned parts of the old canal before referred to, the muskrat built houses for the first time in this part of the State. They were few in number, and were confined to wet tracts, the source of whose water supply was springs from the neighboring Silurian hills, or in swamps adjacent to the line of the canal. Until within the past three years no houses had been built along the water-power canal between Brookville and Laurel. Each succeeding year I noticed the erection of a few more houses, until at this time there are a dozen or more within the fifteen miles just mentioned. Within ten miles of the northern end of this artificial water-way, in the old bed of the canal, have been several houses for a number of years. Whether this house-building habit is caused by some of the house-building muskrats coming from up the stream, or whether, from some unknown reason, the animals of our own locality have thus taken upon themselves this much of the ways of some distant ancestor, we cannot say. That muskrats do, from force of circumstances, change their location, is a well-known fact, and such a change would perhaps be the most logical way to account for the recent house-building just mentioned.

I have made careful examination of some of these houses, and herewith present some extracts from my notes on one of them which I consider typical in construction and arrangement. The examination of this house was made in January last when the ground was frozen, but the more rapid streams had little or no ice upon them. This particular house was built upon the highest part of a piece of marshy ground on a peninsula extending into a stream which passed through the marsh. The end of the peninsula had been dug off to the level of the bottom of the stream, leaving a semicircular exposure of land. A part of the base of the house followed the configuration of the edge of this excavation, while the remainder of the foundation rested upon the bottom of the stream. In consequence of this rather more than half of the house adjoined the water. The house was composed chiefly of swamp grass, sedge, coarse weeds and mud, while fresh-water algæ, small pieces of drift, a few pieces of shingles and two staves were found among the more common material. The greater part of the mud was in the lower part of the house, and I think was mostly brought in attached to the roots of grass. The ground in the neighborhood of this house was cleared of all

vegetation, even of the roots, for some distance. The house was thatched very nicely with weeds and sedge. The ground plan was oval in outline, four feet six inches wide and six feet three inches long. On the land side the house was two feet six inches high, and on the water side three feet four inches. The whole presented the appearance, in miniature, of an oblong hay rick. The inside was quite irregular. Measurements at the bottom of the chamber showed the greatest length to be twenty-two inches, the least sixteen inches, with an average width of twelve inches. The greatest height, measuring from the bottom of the stream, was one foot. Six inches from the bottom a shelf was found running from the left of the entrance and above the top of the water. This shelf was twelve inches long and eight inches wide, and ranged from six to eight inches in height. It was arched over very neatly with drift and coarse weeds. At a point farthest from the center of the chamber, immediately over the shelf, was a passage leading upwards toward the side of the house. While it did not penetrate the wall, it passed through the more compact portion and enabled the inmates to obtain air. Entrance was had through a covered way from and beneath the water without to the center of the house, where it terminated in a mass of fine grass and mud, through which was a funnel-shaped opening to the interior. This house was completely destroyed; within a week after its destruction the muskrats had erected a new home upon the site of the old one. In securing material for this they had used the remains of the ruined house, and had cleared a much larger space of ground of its withered vegetation. In outline the new house resembled the old one very much, but it was of nearly double the size of the ruined structure. There are peculiarities in the shape of many houses, but that which I have described appears typical in form and in interior arrangement of these structures in this vicinity. Some of these houses are built at a time when the water is low, and as the fall rains swell the streams the rats are compelled to ,reconstruct their buildings, raising the top above the highest level of the water. I knew a muskrat to try this plan last year. It built its house within the banks of an ice-pond which was almost dry; as the water was turned on, late in the fall, the owner tried, by making the house higher, to keep a portion of the structure above the encroaching water. An increase in altitude of six feet was too much for the

industrious animal; by the time half this height was reached he gave up the work. Occasionally instead of laying a part of the foundation out of the water, the house is begun entirely within the water. At times I have known a hollow stump, which had a lower opening beneath the water, to be used. The stump being covered over and some grass and other material placed around the base, it required close observation to recognize the framework of the structure. I have known these animals to take possession of a barrel which stood on its end in the water, and after covering it over so as to almost hide it, to give up the work and erect a dwelling without the substantial assistance such an article would afford.

I find the muskrat lives, the greater part of the year, in its sinuous galleries in the banks of our streams. Each autumn new houses are built or old ones repaired, but these are only occupied when the surrounding streams are locked in a sheet of ice. At such times it is by no means uncommon to find several representatives of the species living in harmony within one of these winter homes. I am convinced that in this vicinity one brood of muskrats is regularly brought forth each year. There are, in all probability, occasional exceptions to this rule, when perhaps two and even three broods are born. Mating takes place late in February or early in March, depending upon the condition of the weather, and continues about three weeks. This year these animals were first noted as mating on March 10th. At this season the female utters a hoarse squeal by which the males are attracted. The period of gestation is about six weeks. In April or early May the young are brought forth; from four to six helpless and hairless little creatures may then be found by the persevering investigator far within the subterranean home within a nest of grass and other soft vegetable growth. The young remain in the nest until they are about half grown, unless their home be flooded, when they often perish, but in some instances are rescued by the mother. Mr. E. R. Quick relates one instance when, during a flood July 3d, 1873, he saw a female muskrat swimming along in the muddy water with five young, about the size of a full-grown house rat, holding on to tufts of the mother's hair with their mouths, while she made her way slowly and cautiously along the shore; carefully she avoided all obstructions and swift water, seeking a shelter for her precious tow. Some boyish enemy, per-

ceiving the homeless family, threw a stone which struck the mother and scattered the young. The latter apparently knew nothing of diving and but little of swimming; with difficulty they gained the shore, and while seeking the protection of some reeds a part of them were caught. I have never found the young caring for themselves until after the beginning of July. In September, a few years since, a litter of young was taken from a nest in the canal bank. They were not over one-third grown. This record I have always considered as referring to a second or perhaps a third brood, and is my only note that would indicate a plurality of broods.

During the rutting season the grunts of the males answer the squealing of the females, the noise of scuffles between the males, the continuous splashing made by the animals in the water fill the air, in the vicinity of one of their favorite ponds, with sounds which would surprise one who was not familiar with the neighborhood of a muskrat's home, on a warm night in early spring. At this time of the year they are seen during daylight more than at any other, sometimes even deigning to show their love-making to inquiring eyes.

Muskrats are naturally herbivorous. They feed upon land and water plants alike, in some instances using roots, stems and fruit. They are noted enemies of the "bottom" farmer. In his fields it is that corn grows most plentifully, and upon this cereal muskrats love to feed. They eat corn at any time after it is planted, taking the seed from the ground or the young plant from the furrow. The greatest damage is done after the ear is well formed. "Roasting ears" appear to be a favorite article of food with them. From this time until the corn is gathered, nightly visits are made to the nighboring cornfield, where the stalks are cut down and sometimes carried to their homes, but more frequently the juicy ear is the only part taken. At times streams near cornfields seem covered with floating stalks, the result of the muskrat's nocturnal forays. As the corn becomes hard it is frequently a difficult question for them to tell how they will get the grains off the cob as easily as formerly. They evidently master the question in some instances, for I have known them to deposit the flinty ears in a stream for two or three days until the grains become soft, when they could be readily removed. It seems strange that an animal having teeth of the cutting power those of the muskrat possess,

should seek to do this, but in all probability the teeth, from continued eating of vegetable food throughout the summer, become tender and are unable to cut hard grains of corn with ease. This is the case with many domestic animals in autumn when fed on corn after some months of pasture life. Muskrats are very fond of parsnips, turnips and apples. They frequent apple orchards and turnip patches, near their homes, and make use of much of the farmer's abundant crop of these articles. When snow, which had lain on the ground for some time, melted, I have observed that plats of grass near the water's edge had been eaten bare by these animals while they were confined to such diet as they could find beneath the ice. Their food is not entirely vegetable; in winter and in early spring they subsist, in a great part, upon the flesh of river mussels. Many a winter morning have I found a number of well cleaned shells of the more delicate mussels upon the ice near swift, running water. I have never been able to satisfy myself that this food was used by them at any other time of the year. Neither do I believe that this material was originally so used. It is very probable that owing to the scarcity of suitable vegetable food, they have been forced to include the meat of the mussel among their articles of diet; largely on account of its abundance near their watery haunts and also on account of the ease with which it is obtained. Such change of food has not occurred in this region within historic time, perhaps, but it is evident that formerly, when there were few mussels in these rivers, not so many of them were eaten. With the conditions favorable to their development produced by our canal, mussels multiplied very rapidly, and in proportion to their increase in numbers the muskrat increased his mussel-eating. Records of this are preserved in the banks of the canal; alternate deposits of shells, cleaned by the muskrat, and of sediment may be seen in many localities reaching to the depth of two feet below the present bed of the stream. Upon these same piles of bivalve remains the muskrat leaves the remains of most of the mussels it eats. I have never known the muskrat to eat univalve mollusks. I have identified the following shells as forming the principal part of its bivalve food in this vicinity: *Anodonta plana* Lea, *A. decora* Lea, *A. imbecillus* Say, *Unio luteolus* Lam., *U. parvus* Barnes, *Margaritana rugosa* Lea, and *M. complanata* Lea; all common in proportion to their comparative abundance. In some localities I

found the young of *Unio occidens* Lea, but not very common. In another locality where *Unio lachrymosus* Lea is the prevailing species, I found its shells forming the bulk of the refuse near muskrat homes. In this same locality I found examples of *Unio plicatus* LeS. and *U. multiplicatus* Lea, but they were not common. The young of heavier shells are to be found as commonly, in proportion to their abundance in the adjacent water, as are the remains of the more fragile species. I have estimated that about one-half the mollusks eaten are of the three species of Anodonta. I was surprised at the comparative abundance of the remains of *Margaritana rugosa* Lea in these piles of shells. This species is considered to be rather rare, but their shells are found as frequently there as are those of some of our more common species. From this fact I think the muskrat prefers the flesh of this species to that of others which might be more easily taken. I have, at times, found examples of living Unios among these heaps of shells; whether these had been brought there by the rats, or whether they had sought, of their own accord, a dwelling place among the remains of their dead ancestors I cannot say. The means by which the muskrat secures the body of a mussel has been frequently discussed of late. I think, from my observations, there are three ways in which these shells are opened. With many species I notice that the foot is very slowly withdrawn within the covering when the shell is handled. When such shells are taken it is very easy for the muskrat to insert its paws or long teeth between the valves and tear them asunder. The remains of some species show evidence of the cutting power of their enemy's teeth, the edges are broken; when this is done it would be very easy for the muskrat to find a sufficient opening to secure the animal as in the preceding instance. By those two ways the more fragile shells may be opened; the heavier species which are occasionally found, nicely cleaned, about the opening of the muskrat's home, could not be opened in this manner. I have on several occasions noticed these larger mussels lying on the bank of a stream near a muskrat hole, and within a few days they disappeared. The only way in which I can see the muskrat could obtain the body of one of these larger mollusks is by leaving the animal out of the water until it becomes weak or until it dies, when the valves could be easily separated. Muskrats at times eat of the bodies of dead animals. The remains of ducks, geese,

chickens, fish, and even in one instance a turtle, have been noted as forming a part of their food. The farmers of the lowlands ascribe to the muskrat a love for young ducks, but I think the greater part of their loss in this particular is referable to turtles.

The muskrat is largely nocturnal in its habits. On cloudy days and occasionally late in the afternoon one may be seen, along some quiet stretch of water, seeking food or looking for its mate. It is not much at ease on land, although when pursued it moves over the ground at an ambling gait with some degree of rapidity. It is an expert at swimming and diving. Before diving it appears to inflate its lungs with air, and when it disappears remains beneath the water for some time, the course it takes being frequently traceable by rising bubbles of air. When surprised it plunges into the water suddenly without the necessary supply of air, and is forced to come to the surface in a very short time. When frightened it generally seeks its hole, but such is not always the case. In open water it dives to a considerable depth, and I have noticed it passing through shallow water apparently running upon the bottom. Under the ice it may be noticed, at times, swimming quite close to the surface of the water. It appears disinclined to dive in muddy water. Upon several occasions, when our streams have been swollen, I have attempted to make one dive by stoning it, but generally without success; sometimes it would dive, but would almost immediately reappear. When our water-courses are covered with ice the muskrat has regular places of egress and ingress, such places being where, owing to swift water, ice had not formed, or where the ice along the banks of a stream had become broken.

Several methods are employed to capture or to kill muskrats. Many of them are caught by means of steel traps. They are very unsuspicious and regularly become the victims of their self-assurance. A dead fall is frequently used with some effect. It is generally placed over a well-worn runway leading to a favorite feeding ground. Many muskrats are killed by means of poisoned apples or turnips which are placed in the neighborhood of their burrows. The latter plan is often tried by the farmers of our uplands to kill these animals when they become too numerous in the ditches and smaller streams. A method used with great success by a local water-power company, in winter, is as follows: A barrel with both ends out is placed upright near the bank with

about half its length in the water. Upon the water inside the barrel is placed grass and weeds, and on this foundation the bait, generally a few pieces of parsnip, is put. In a few days the animals will become familiar with this new object, and thereafter the barrel may be visited regularly. After a warm night the trapper is reasonably sure of finding some game in his barrel. Sometimes he will find but one or two rats, but more frequently he will catch from three to six, and on one occasion I have known ten rats to be taken in one barrel in a single night. At mating time if a female be caught several males will be taken prisoners in the same barrel in their efforts to become her company. When a rat gets into the barrel it is impossible, owing to the depth of the water, for it to stand upon its hinder limbs to cut a hole in the staves above water line, and at the same time impossible for it to get out at the top of the barrel. When several are taken the same night a fight generally ensues, resulting in the death of all of the captives either by the sharp teeth of their companions or by drowning. I have known instances where several of these rats had been captured and killed, but the trapper did not visit his traps for some time; upon his arrival, however, he found but a few heads and bones to tell of the tragedy that had been enacted and of the feast which the other muskrats had when the water receded enough for them to enter and leave the barrel. This habit is not uncommon when more acceptable food is scarce. Last spring a muskrat was caught in a steel trap; when the trapper went to his trap next morning he found another rat eating the dead one; upon examination it was found the entire right shoulder had been eaten off. Spears are rarely used, but they are sometimes brought into service when the streams are ice bound to kill the inhabitants of a winter house. Many muskrats are shot in early spring when the ice breaks up.

Of the enemies of the muskrat man ranks first, and next to him the dog. Hawks and owls of the larger species, foxes and minks are all very destructive to this animal. The mink is perhaps it greatest natural enemy, but fortunately for it minks are rare. The remains of muskrats have, on several occasions, been found in the stomachs of large catfish, but the flavor of the food had been so thoroughly imparted to the meat of the fish that it was unfit to eat. The muskrat is at times very ferocious. When cornered by dogs or man it frequently shows fight, and if pressed too closely is able to do much execution with its sharp teeth.

Muskrats have their pleasures as do other animals, but as their favorite time for sport is after night, we have but little opportunity to become acquainted with them socially. On a warm quiet afternoon they appear to enjoy a sunning in some secluded spot. Their gambols in the water, of a quiet evening, remind me much of the playing of kittens. They may be seen at times, of a moonlight night, chasing each other over some sand bar near their watery home. On the whole a study of their enjoyments is very unsatisfactory, and much of our knowledge of the life history of these animals will be but slowly acquired.

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THE PROBLEM OF THE SOARING BIRD.

BY I. LANCASTER.

IT is now more than two years since I first made known the results of investigations on the methods of flight of the great soaring birds, carried on at intervals since 1850. The whooping cranes of the Northwest, performing their migrations on motionless wings, had at that early date fixed my attention, and my times of leisure down to 1876 were devoted to ransacking the scientific and literary world and to observing the birds in the act whenever it was possible to do so, that I might get an explanation of the phenomenon of more substantial character than mere guess-work. Plenty of assumed solutions were found scattered about. Such theologians as I consulted were confident that the question had reached its lowest terms when it was said that "God had created the birds to fly." Common-sense folks rejected the idea of fixed wings and held to a slow flapping that could not be seen, while the scientists were confident of upward slanting currents of air and various atmospheric disturbances which produced the result. Accounts of travelers as to the facts were hopelessly confused, with a single exception, that of Charles Darwin in his Naturalist's Voyage around the World. His solution of the matter, that of the surging head, was given provisionally.

I was not prepared to deny any of the solutions given and not more ready to admit them, being conscious of very much ignorance of the entire matter. Meanwhile my interest in the subject, constantly increasing, had, in 1876, overshadowed all others, and being disengaged from business, I devoted the ensuing five

years to the birds on the Gulf coast of South Florida, where the soaring varieties were found in abundance, fully intending to unravel the case before leaving it. The task was a hard one, and the final solution was found in a totally unexpected direction. The predominant feeling I have since experienced in regard to it is one of surprise—surprise that in this ceaselessly active age mechanical possibilities of the most important character could exist in the atmospheric spaces all about us, with many of the largest species of existing birds putting them in daily practice before our eyes, and we still remaining completely ignorant of them! I propose in this paper to present, first, a few of the most significant facts exhibited by the soaring birds; next, to offer an explanation of the phenomenon; and finally, to examine the bearing of what has been said on the problem of artificial air-navigation.

I mean by a "soaring bird" one which habitually travels the air on motionless wings. All birds flap their pinions at times, and many of the smaller kinds, such as rooks, kestrels, crows and gulls can maintain flight on fixed wings when the conditions are favorable. But I would never think of observing them for lessons in soaring. They are too light to average the inequalities in the air current, and there are frequently long intervals of active wings before the fixed conditions occur. The soaring varieties are at it all the time. The frigate birds live in the air night and day for a week at a time without touching a roost. Their congeners, the buzzards, spend the day in the same style. The various cranes common to the coast often spend hours resting in the air, while the gannet is an admirable soaring bird with a heavy body and relatively small expanse of wings.

When I speak of "fixed" or "motionless" wings the meaning is that no muscular power is used to either overcome weight or air resistance. It is not meant that the pinions are absolutely rigid, like a board, for they are moved to accomplish change both in shape and position. But they do precisely resemble a board so far as the exertion of motive power is concerned. For instance, if a bird floats in a wind of unvarying velocity over any fixed point on the earth, then if a board of the same shape and size and weight were put in its place, it would remain there just as the bird does, as long as the conditions were unchanged. If the bird slightly changed the shape or position of its surfaces so as to ver-

tically ascend indefinitely, the board would also ascend in the same way were it to be changed in a similar manner.

This is seen in the performances of what I have termed "effigies." They were surfaces of veneer or cardboard fastened to a frame and balanced by a weighted pendant. They would simulate the actions of "soaring" perfectly. I have made numbers of them. They would leave the hand and travel against the wind for as much as 500 yards, remaining up for fifteen minutes. They had no ability to automatically balance themselves in unsteady currents of air, but they were good illustrations of "soaring."

The first thing to be definitely ascertained was whether the wings of the soaring birds were in fact as motionless as they seemed. To determine this point demanded close inspection, and although the creatures were not fearful of man in that remote country, they preferred a distance of thirty to forty feet away. The captive bird was useless for any critical test. 'Tis true that a bird ten feet in alar dimensions, resting horizontally above one's head thirty feet away, with the clear sky as a background, could be pretty well examined; still a closer position was not only desirable but imperative, and a resort was had to the arts of mimicry with entire success. Procuring a few square yards of thin muslin fabric sufficient to completely envelope my person, it was covered with paint of the green and brown shades so as to resemble the tree tops of localities in the vicinity of either the breeding places or the roosts of the soaring birds, and barring the unpleasant sensation one has when engaged in the arts of gross deception, I had everything pretty much my own way. Some trouble was experienced in striking the happy mean of scaring the great creatures enough to keep them from alighting on my face, and still not frighten them away, as they were totally oblivious of my presence. Wing movements could now be studied in every conceivable position at leisure, endwise, sidewise, from above, from beneath, and at every sort of obliquity. The conclusions of observations made from the ground at thirty feet distance were confirmed from the tree-top stations at all distances, from twelve inches upwards. In the first Florida year, observations were made with good results about 150 times, during which all the varieties of soaring birds of 100 miles of coast line were viewed. The trees of the country are short and stunted, and

easily climbed, and a little search was rewarded by the discovery of thick sturdy tops in which a secure lodgment could be had. The birds abounded in prodigious numbers, thousands occupying a single roosting ground. Not only was it seen that there was no motion of the wing as a whole, but that there was none of the individual feathers. There was no tremor, no slow nor fast waving; the entire bird moved when the wing did. When the wing was flapped there was no doubt about it, and the flapping could be seen as far almost as the bird was visible. Both the "soaring" and flapping were discoverable when they occurred beyond any doubt whatever. To determine horizontality of the sea breezes of the coast, a radial arm, feathered and balanced level, was used. It is evident that somewhere in the interior of the peninsula there must be an upward trend of the meeting winds from the Atlantic and Gulf, but there is none discoverable on the western coast. The wind, twenty-five feet above tide, moves uniformly on level lines, and ten feet above the forest tree tops no upward flow can be found. The lantern of Egmont light, 150 feet high, at the entrance of Tampa bay, was frequently used for these atmospheric observations.

There is a wide range in the relation between weight of bird and wing surface in the different species. It varies from less than one, to more than two feet for each pound weight. Uniformly the longer the wing to a given weight the greater the power of translation possessed by the bird, the man-of-war hawks in this respect surpassing all others. Wide, short wings were coupled with heavy bodies, as in the gannets, and these exhibited slower but steadier flight. The heavier the bird the steadier and easier seemed its movements, and a hungry vulture, which was very shaky in the breeze, could ride serenely when gorged with carrion.

The only peculiarities discoverable in the atmospheric condition required for soaring, was that the wind in all cases should move against the bird. The maximum velocity of this meeting of bird and air is unknown to me. I have timed the flight of frigate birds through calm air on fixed wings at 100 miles per hour, and their velocity seems to depend on their wishes more than on any limitation of the powers of translation. The minimum speed, however, can be approximated. For the frigate bird it is about two miles per hour, three for the buzzards and five for the gannets. The heavier the bird the greater is the minimum velocity required, and a gorged vulture cannot range itself with a flock of hungry ones, which are sporting in their minimum, without repeatedly flapping its wings.

(*To be continued.*)

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 953, October number.)

VI. The Mental Organism.

WE have now to consider a question of very great importance, that of the relations of the mind and its energies to the universe of matter and energy without. A review of the conditions of mental energy leads to conclusions of much significance. These, however, can only be given very briefly, but we will endeavor to point out their leading features and show the direction in which they tend and the remote possibilities of mental development which they indicate.

In the lowest animals, in which psychical powers are yet very feebly developed, if they exist at all, the inflowing energy makes its way at once to the muscular or contractile regions, and motion takes place in response. The action of external nature upon the body is immediately followed by a reaction of the body upon external nature. Where this action and reaction are in harmony, the body is a well-adapted reflex organism. As already said, however, with every new condition in the action the reaction becomes general, and new special adaptation is only slowly gained. And where there exists the rudiment of a psychical organism every sensory action of a new character probably always disturbs its conditions, yields a conscious sensation and affects its motor relations. By a long continuance of this process the mental organism becomes greatly developed. Of the external energies which crowd into the body during this increase in sensory and mental powers a constantly smaller percentage goes directly to the muscles, and a larger percentage to the mind, into which they enter as organizing or otherwise affecting agencies. Thus the energies which are checked in their flow through the body are never lost, but are employed in building up a reservoir of energies within. Instead of producing an immediate and direct reaction upon outer nature, they now produce a retarded and indirect reaction. The condition of affairs is vitally changed by this new condition of the organism. The body is at first an instrument of external nature alone. It is set in motion by the energies of certain external substances, and exerts energy on other external substances. But in its advanced condition the force of the external

energies is mainly exerted upon a fixed region of the organism, in which they become definitely centered and organized. And this reservoir of energies in its turn reacts upon outer nature. Instead of a single agent of action, with the body for its instrument, we have now two agents, an internal and an external one, with the body for their instrument. The nervous organism serves as the channel of intercommunication between these two active agents. And the high-atomed chemical molecules of the nerve cells or terminations, whether those of the outer surface, the muscles or the cerebrum, serve as sources of intermediate energy, which add to the vigor of the slight motor impulses from without or from within. In this view the mind is as little a necessary constituent part of the body as is outer nature. The body can perform its ordinary duties without the mind or its organ, and needs it only for its extraordinary duties.

In its primary relation this new condition of the organism only acts as a check on the rapidity of motor reaction. The mental affections retain their original form, and their reaction, when it takes place, will be of the same character as the immediate reaction would have been. But the mental organism soon begins to act as an independent agent. From the conditions impressed on it, new conditions are produced. There is an internal reaction and new combination of the mental energies. Memories combine to form thoughts or ideas, and motor relations are gained within the mind which have no counterpart without. These, in their turn, react on outer nature and yield peculiar results, no longer in consonance with external conditions. The microcosm without has built up a microcosm within, with powers and conditions of its own, and the body now becomes the intermedium between two independent and dissimilar acting agents. These may act only within themselves, or they may act upon each other through the medium of the body, each producing special modifications in the condition of the other.

These general considerations lead to more special ones. What is the character of the impressions produced by external energy upon the mental organism? These external energies are yielded by the substances of external nature, and in some way represent the conditions of these substances. As such they enter the body and impress the mind. Though all sensations may be conveyed over the nerve fibers as vibratory impulses, yet there must be some

difference in the character of these vibrations with every new kind of sensation, since the mind receives a peculiar impression from every peculiar sensory impulse. The memories thus implanted in the mind represent to us the conditions which exist without us. This representation very possibly may not be an exact one. Possibly it is only analogically similar. But it is all we know of external nature, and although each impression may not truly reproduce the condition from which it arose, there can be no doubt that the relations between these impressions are correct. The picture must be correct as an analogical reproduction if not as an actual one. It must be borne in mind also that the impressions received indicate the motor conditions of external substances, and that they become motor conditions of the psychical substance, so that their exactness of representation may be much closer than is usually surmised.

The mental organism thus acts as a mirror, in which the universe becomes more or less fully reflected. Its memories are reproductions, more or less exact, of external conditions, and it exists as, in a partial measure, a counterpart of external nature. But it is much more than this. Its powers are not confined to the reception and storage of external energy and the reflective reproduction of the forms and forces which emitted these energies, but it has a reorganizing power of its own. Its energies combine and produce new conditions, which may or may not have a counterpart in external nature. If these new productions are the outcome of reason they may represent conditions or forces in nature which are not apparent to our senses, as, for instance, the attraction of gravitation, or the vibrations of heat and light. If they are the outcome of imagination they may represent conditions which do not exist in nature and which are new creations of the mind.

The vision of a cathedral, for example, gives us a mental impression which becomes persistent. The mind has henceforth among its stores the image or representation of the external compound of matter which we call cathedral. A picture or a description of a cathedral may produce the same image. Close observation gives minute knowledge of the constituent parts of this edifice, and reasoning yields what the senses cannot convey, a conception of the architectural principles involved and of the forces at work in binding the parts of this structure together

down to its very chemical atoms. Thus by sensation and reasoning the mind gains a very minute and complete image of the edifice, which it may review in part or in the whole, as it will. The building seems to be erected in the mind, by the ease with which it can be mentally taken apart and put together, and each of its parts called up as a separate and distinct image.

But the mental powers can go much further than this. They can make different combinations of the separate parts of such an edifice and work out different results of the principles of architecture, and thus produce a compound not existent in external nature. This is the work of the imaginative or constructive faculty. In both these cases we seem to have but varied combinations of the mental images or energies. But the new form of building thus mentally constructed need not be confined to the mind. It can be erected in outer nature by the aid of the hands, or of other minds and hands. Thus as the mind mirrors external nature, the external may be made to mirror the mind. After beholding the cathedral there exists an image in the mind corresponding to a condition of external nature. After erecting the new edifice there exists a form in external nature corresponding to an image or condition of the mind. Mind and nature act and react upon, and each molds and modifies the other. The illustration here given might be endlessly paralleled, since it represents the general character of all the mental operations.

Evidently, then, the process of development is two-fold. The mind is being developed under influences derived from without, and the outer world under influences derived from within the body. The mind and the universe are becoming counterparts of each other, the one in external matter, the other in that unknown substance which is the basis of mind. Thus every mind is becoming a partial counterpart of the universe. At first this mirroring of the universe is very slight and imperfect. The mirror is of minute surface and very clouded in texture. But with the growth of knowledge it widens and grows clearer, and a continually greater breadth of the universe is reflected within it. If developed to its utmost conceivable extent, it might take in the whole universe and constitute a reproduction, in its special and localized conditions, of all the conditions existing in the broad range of external nature. Like the monads of Leibnitz, each of which was conceived to mirror all others, and each from its own special

point of view, each mind might come to mirror all things, physical or mental, and each from its own special point of reflection. Such a duplication of the conditions of the universe would be the necessary result of the infinite expansion of the relations of the mind of man to external nature.

The mode in which the thought constituents of the mind present themselves to consciousness strongly point to the above conclusion. We seem to become conscious of the existence of a counterpart, within our minds, of the universe, so far as we have come into rapport with it. There lie the forms surrounding us, the trees, houses, plains, mountains, &c., down to their smallest details, and each in its appropriate relation, alike of force and of position, to the others. With extended knowledge we gain a mental picture of the whole earth, with its diversity of natural scenery, its continents and oceans, its empires, cities and inhabitants, human and brute. The geological conditions of its surface are similarly apparent to us, and the deeper regions, so far as we are aware of their conditions. The intermotions and connecting forces and principles of these objects also form part of the mental reproduction. None of us have ever seen the whole of this picture. It has been mainly conveyed to our minds as a reflection from images present to other minds. Yet if we wish to see the earth we have but to look into the depths of our minds, and there we behold it, with all its parts arranged in their due order and relation. The mental universe of man is far more extensive than this. It stretches downward to include the minutest forms. We can even perceive the excessively minute atoms going through their endless dance, and the vibrations of the ether as radiations of light and heat run swiftly through it. It stretches upward to include the mightiest forms, the revolving planets and shining suns, each with its peculiar motions and attractive vigor. To see all this we do not need to look around us. We have but to look into our minds, into which it has entered and organized itself. The whole or a part may be seen at will, often falsely perhaps, from imperfect conceptions, but there lies our visible universe as it appears to our eyes, has arisen through the exercise of our reason, or has come to us at second hand from the eyes and minds of others.

We may, for instance, call up the memory of a tree. If we compare this image with the visual image of an actual tree there

will be no apparent difference, except in the greater vividness and sharpness of the latter. And it is remarkable how new impressions of an object annex themselves to those previously received, and thus fill out the original image. Our first idea of the human body is a mere outline. To this are gradually added impressions of its distinctive surface parts, its internal organs, its tissues, circulation, &c., its motions, and its general principles of formation and physiological functions. Each of these falls into its proper relation with the others, building up a full ideal image of the body. But this image retains the character of a manikin. It can be taken apart at will, and each part considered separately from the rest. This essential peculiarity pertains to all ideal conceptions. They have none of the necessary coherence of natural organisms. The conception never becomes an indissoluble mental image. It may be anatomized, as the body may, but without need of the slow process of dissection.

As to the part taken by the different senses in building up this mental picture there are important distinctions. Some yield us impressions of form and some of quality. The senses of smell, taste and hearing simply advise us of certain qualities or conditions of external things. Touch and sight also yield impressions of quality, but of form as well. They acquaint us with the space extension of objects, and also with their space relations and motions. It appears strange how the mind can gain a permanent record of the motions of one body in relation to others. We can only comprehend it as a record of form relations with time extension, the sensory impression of a very rapidly succeeding series of pictures on the mind, in each of which the relation of position of objects is changed. On recalling to consciousness this series of pictures the idea of movement must arise with it, precisely as occurs in the optical toy where a series of gradually differing pictures are blended by rapid succession on a moving disk, and the figures made to appear as if in actual motion. The impression of a musical air on the mind is probably of analogous character to the above, a time succession of differing sensations.

The reason has much to do with the correctness of our impressions of form. The eye receives its picture as a flat one, and it must affect the mind as such. The blind restored to sight see landscapes as flat pictures. Touch is necessary to make sure of the solidity of objects. Yet the pictures on the retina of the eye

differ from those on canvas in the perfection of their perspective and of their arrangement of light and shade. The effect on the mind may be that which any picture that was absolutely perfect in these respects would produce on the eye.

If we continue to view the mind as a substantial organism, and its conditions as due to the motor relations of the parts of this organism, the mode of impression of a formal image on it may bear some relation to photography.

It may seem inexplicable that the same nerve fiber in conveying currents of energy can yield such different impressions as these currents vary in their source. It might be argued that such currents could only differ in degree and not in kind. And yet the eye receives its pictures from currents of energy conveyed through a single medium, that of the vibrating ether. The variations in light and shade, color, &c., are due to variations in the conditions of this energy, and similar variations may exist in the nerve current. As an object photographs itself, through the effects of these variations in the energy of light, on a sensitive tablet, so the retinal picture of such an object, through similar variations in the energy of the nerve current, may produce an analogous effect on the sensitive mental tablet.

The idea of photography, of course, is offered but as an illustration of a sensitiveness of inorganic substance which imitates, though remotely, that of the mind. In the instantaneous photography of recent years plates are made of such exquisite sensitiveness as to take a good picture in a very minute fraction of a second. While these plates are kept from the light no change is produced in them. The instant the light falls upon them an exact surface copy of the object from which it emanates is produced on the sensitive plate. And this picture becomes a permanent condition of the plate. Some change has been produced in its motor or chemical organization, and the picture remains an indissoluble characteristic of its subsequent organization.[1] The parallel this presents to the mind, viewed as a sensi-

[1] In illustration of the sensitiveness of material surfaces we may quote from Professor Draper: "If on a cold polished piece of metal any object, as a wafer, is laid, and the metal then be breathed upon, and when the moisture has had time to disappear the wafer be thrown off, now upon the polished surface the most critical inspection can discover no trace of any form. If we breathe upon it a spectral figure of the wafer comes into view, and this may be done again and again. Nay, even more, if the polished metal be carefully put aside, and be so kept for many months

tive organism, is strikingly complete. We may, as an analogy, view this organism as having a delicately sensitive surface, which remains unaffected while it is kept from the influence of the nerve current, like the photographic plate when kept from the light. But the instant the energy of this current touches it a pictured image is produced which closely represents the object which instigated the nerve current. And this picture becomes a permanent condition of the mind. It indicates a fixed change in its motor organization. In this respect, however, the mind represents a photographic plate of extraordinary sensitiveness, one in which we might imagine that each picture sinks below the surface, or a new sensitive surface is immediately formed over it.

We may pursue this analogy of the organism of the mind to conceivable photographic conditions somewhat further, and reach other interesting conclusions. In this connection the relations which our mental impressions bear to each other form an important subject of inquiry. These relations are of two kinds, one of similarity, either direct or analogous, and the other of contiguity in time of reception. Each new impression seems to connect itself with all preceding similar impressions in such a manner that consciousness of the one tends to recall the other to consciousness, this effect being the more marked the greater the resemblance. As intimate a relation exists between impressions received together, although they may be very unlike. Their connection in time serves as a link of combination. They elbow each other in the mind, as it were.

These are the two distinguishing features of remembrance, and seem to point to two distinct conditions under which the mind retains its images. In regard to contiguity in time the recall of a mental image seems to recall the whole surface condition of the

(I have witnessed it even after a year), on breathing again upon it the shadowy form emerges. Or if a sheet of paper, on which a key or other object is laid, be carried for a few moments into the sunshine and then instantaneously viewed in the dark, the key being simultaneously removed, a fading spectre of the key on the paper will be seen; and if the paper be put away where nothing can disturb it, and so kept for many months, at the end thereof, if it be carried into a dark place and laid upon a piece of hot metal, the spectre of the key will come forth. In the case of bodies more highly phosphorescent than paper, the spectres of many different objects, which may have been in succession laid originally thereupon, will, upon warming, emerge in their proper order. Indeed, I believe that a shadow never falls upon a wall without leaving thereupon its permanent trace—a trace which might be made visible by resort to proper measures" (Physiology, p. 288).

mind as it existed at the time of reception of that image. It is as if, as above said, the mental organism at each period presented a clear surface for the photographing of impressions, which was immediately covered by a new-formed surface. In this view the mind seems to present itself as an unlimited series of overlapping laminæ, on each of which is photographed the thoughts and events of one period of life, while the touching of any special lamina by consciousness calls up to the mental vision all the contiguous impressions on that lamina. And the fixed hereditary constitution of the mind may be a deep-laid foundation, overlaid by these succeeding formations and far beneath the reach of consciousness, yet exercising a vigorous influence over the later developmental processes of the organism. Another point necessary to mention is that physical impressions and mental conceptions appear to affect the mind in the same manner, so that it becomes sometimes difficult to distinguish between a sensation, a memory or an idea. In states of hallucination no line of demarkation remains, and at any time the principal distinction seems that of vividness. The mind apparently retains its images in but a single mode.

The relation of similarity adds another structural feature to this conception of the mind. If we see a fine view to-day it may call up to our mental vision a somewhat similar one seen ten or twenty years ago. We have reason to believe that identical impressions flow together and strengthen their resultant, until the mind may very feebly respond to an incessant repetition of the same image. The motor conditions of the mind are so in harmony with the sensation that it produces a hardly appreciable disturbance. This would indicate that identical impressions affect a fixed locality in the mental organism, and the same may be the case, in a less exact degree, with all similar impressions. In such a case the relation would not be one of surface contiguity, but of vertical contiguity, the localized impression being in close relation of position to all similar ones lying below it in the depths of the organism. All this, of course, is pure hypothesis, yet it is of interest in connection with the phenomena of the association of ideas, if we consider the mental conditions to be the organizing relations of a substantial organism. Yet one further resultant of this analogical conception of the mind may not be amiss. The sinking of an impression below the sensitive surface of the mind

might have some relation to the frequent difficulty of recalling an old memory, and the general disappearance of memories from the grasp of consciousness, until recalled by some association. For consciousness may be looked upon as a superficial affection of the mental organism, aroused only when this surface is acted upon by cerebral energy. But present sensations might be able to connect themselves with old memories in the manner just described. And in so doing they might rouse a whole sheet of memories, spread over some deep mental lamina. The energy which produces a surface consciousness, through rapport between the mind and the cerebrum, might through this rapport of the mental laminæ make its way to deeper regions, and awake long dormant impressions of the mind.

The hypothetical idea of the constitution and development of the mental organism just given, while perhaps very remotely analogous to the reality, yet answers to the conditions of sensory reception and memory with sufficient exactness to be worthy of a clearer delineation. In this view, then, each man derives hereditarily a firmly-constituted germ of the mental organism, destitute of ancestral experiences, yet, like every part of the body, possessed of its innate habits, capable of exercising more or less control over all subsequent mental activities, and also limiting by its conditions the degree and direction of the subsequent development. This is the hereditary mind, the granite rock basis of its future formation. It has no power in itself to develop beyond this. All the other organs of the body may fully unfold from their innate forces while the mind remains in the germ. Its development is a purely individual process, and the results are not transmissible to offspring.

Still considering it as a substantial organism we seem to behold layer after layer of new substance laid down upon it, as strata are laid upon the granite basis of the geologic formation, and taking form from the form of this basic organism. Each of these lamina is delicately sensitive to the impress of external energy, and becomes covered with a series of pictured images, the fossils of the memory. With the formation of each new lamina all preceding ones are buried below the immediate contact of energy and the direct reach of consciousness. But as the impressed images on each lamina are in horizontal contact with each other, so each new impress seems to be drawn to a locality of the organism which

has been the seat of similar impressions. It is as if, in seeking entrance to the mind, it found its easiest channel at the point where impressions of some degree of similarity had already entered. Thus impressions of similar character become vertically in contact or in close contiguity.

This idea certainly offers some explanation of the phenomena of recollection, or the recall of memories. Consciousness is a resultant of the immediate relations of the cerebrum with the surface conditions of the mental organism. It has little or no penetrative power in itself. To receive an impression on a fixed mental locality does not of itself cause disturbance of the impressions which may lie below that locality. But when an impression is added to a vertical series of similar impressions, consciousness seems to make its way downward and to arouse the whole or any specially harmonious part of the series. And on thus reaching any mental lamina it may spread itself widely over that lamina and arouse to our attention a broad sheet of its impressions. Such seems the character of conscious association. No memory is recalled except through direct or indirect links of association with some present phase of surface activity. And no memory remote in time reappears until consciousness first establishes a rapport between some present impress or idea and a somewhat similar one received at that period of time.

The conditions thus impressed on the mental organism from without never remain separate conceptions, like the successive pictures in an album. They combine with each other and establish relations resembling those that exist between the originals. All we perceive are forms, qualities or conditions, and motions. Any deeper knowledge of nature must be attained through the innate operations of the mind. The received motor conditions do not lie passive in the mind, but spread under the influence of consciousness, or the energy which consciousness represents. They gradually exercise their native affinities and establish connections and relations similar to those which they possessed externally. The forces and principles which exist between external forms and conditions become evident between their mental counterparts as memories combine into ideas, and these forces and principles become in their turn objects of conscious conception. The universe tends to repeat itself fully in the mind.

But mental activity does not stop here. Forms and forces also

enter into relations which might possibly exist in outer nature, but which have never existed. Thus the mind erects an ideal world of its own, which it has the power partly to reproduce externally. This power of ideal formation is practically unlimited. The world within to some extent cuts loose from the world without, grows beyond immediate dependence upon it, reproduces the possible as well as the actual, becomes a self-centered and specialized compound of energies, and reacts as a modifying agent on that external world which has so long and so powerfully acted upon it.

As already said, the mind as a developed organism is not, like the remainder of the body structure, transmitted to offspring as a constituent feature of the germ. It must grow up in each individual anew. The most fully developed cerebrum has no power in itself to unfold the mind beyond its embryo stage, the seed of psychic existence which is derived from a long line of ancestors. The fundamental psychic conditions of our ancestors persist in our minds, not as experiences, but as strongly influencing tendencies. We cannot relegate these innate tendencies to any personal experiences, but they have the force of a large body of experiences. They form the fundamental state of our mental organism, over which are laid all its more individual states. They are a collocation of tendencies, inclinations, attributes, emotional strains, &c., which compose the original stuff of the psychic germ, the framework upon which all its later material is molded. From this original strain and the variations produced in it by subsequent experiences, proceeds our mental character, which is thus a combination of heredity and experience. Our own course of thought adds nothing to it, but the shades of change in mental character which are produced during our life may be transmitted to our offspring, and thus evolution take place in the hereditary basis of mind. This mental character forms our great moving power. It may occasionally be overcome by vigorously concentrated thoughts, yet it exercises a control over the action of nearly all our mental motive powers, and forms the great restraining agent of the mind, the concentrated wisdom of a thousand generations. But for it our actions might be very erratic, without a rudder to guide the movements of our headstrong and vagrant thoughts.

Judgment is not a passive, but an active quality. It is the name we give to the concentered vigor of all the thoughts active

in our mind in its calm state, and the sublimate of ancient thought that forms its hereditary strain. The actions we perform, the resolutions we take, are greatly subordinated to this compound of influences. They exert a force which we call will. In emotional states, on the contrary, when a few thoughts, or a single thought, perhaps, are abnormally active and the general sum of thoughts driven deep into unconsciousness, the will is differently conditioned. Vigorous and often abnormal action takes place in response to these active mental energies, and in spite of a dull protest from the nearly banished judgment. The active thought takes the bit between its teeth and runs away with us. The indications are that each conscious thought becomes an agent of control in accordance with its degree of activity, that the force resultant of all the thought activities present to consciousness at any one period constitutes the will-power, and that the action of this will be normal or abnormal in accordance with the diversity or the narrowness of the agencies active in it.

As for the control of the body by the mind, it seems almost as if the latter possessed an exact transcript of the muscular apparatus of the former. Desire to move a certain limb is accompanied by thought of that limb. Does a representation of the desired motion take place in the mind ere action is exerted on the motor nerves? Is there conscious excitation of a region of the mind which is in direct cerebral connection with the limb? We do not think of the muscles, but of the limb to be moved. As the mind contains a conscious transcript of external nature, does it also contain a complete transcript of the body, and does its self-performance of the action desired, upon its image of the physical frame, call into activity that region of the mental organism which communicates with the desired muscle? If every portion of the body is in direct connection with a fixed portion of the cerebrum, as is probably the case, then each portion of the mental organism may possess a similar connection, and to think of a limb is to rouse that part of this organism which is in immediate motor connection with the muscles governing that limb. Much of this connection must be hereditary, and its action a mentally reflex activity. But control of the body by the mind is in considerable part acquired. It seems almost as if the mind sought out the body, and only gradually completed its picture of it, or brought itself into complete motor relations with it.

The usually entertained idea that our mental picture of nature is only analogically correct, which has by some writers been carried to such an extreme as to deny that the external world exists at all, but that the mind and its images constitute the universe, calls for some attention here. The extreme view may be at once dismissed as not consistent with what we know of the laws of energy, which forbids evolutionary changes in a concrete organism except under the influence of energies received from without. And a strong argument may be brought in favor of the view that our conceptions of the external are not illusory, but that the image received by the mind is a close reproduction of the conditions actually existing in external nature.

Bodies are composed of matter, but it is matter molded by force and energy, and all form and quality are due to the interrelations of this energy. Color is due to a special action which is exerted upon the waves of light; sound to an action upon the molecules of the air. Colors and sounds, therefore, while not belonging to the body which seems to emit them, indicate special conditions or qualities of that body. By the study of these special emissions of energy we arrive at deeper conceptions of the true character of the body. Our first conception of any object is very crude and inexact. Exactitude can only be gained by a close scientific study of all these special characteristics and influences of the object. Our senses do not advise us of the real character of matter, but only of its combinations and their properties. Nor are we aware of absolute, but only of relative conditions. Our body, with its conditions, is the standard by which the universe is ordinarily measured. If our body was colder what we now call cold would become warmth. If it was firmer hardness would become softness. If it was larger largeness would become smallness. But science is rapidly ceasing to make the body the test of nature, and has made some steps from the relative towards the absolute. It declares that a certain temperature arises from a certain vigor of vibration, a certain color from a fixed rapidity of vibration, that degrees of hardness arise from fixed degrees of resistance in bodies, &c. It is true that these results are expressed in terms of space and time, and space and time extension must remain to us relative conceptions. Yet nothing else need be relative. If the apparent dimensions of objects are truly related to our conception of space and the dura-

tion of events to our conception of time, they are true to this extent, and within this limitation we may arrive at correct conceptions of existence.

Objects emit energies. These energies are external expressions of the conditions of the object emitting them. So they are acted upon by energies which they partly repel, and which are modified by their momentary connection with the object. On the other hand the energies which penetrate the object from outside act to modify its conditions. In other words, all energies exert a power of leverage. The energies emitted by any object on flowing into another forcibly impress some of their peculiar characteristics upon it. The receiving body is brought into a certain conformity of condition with the emitting body. This leverage is in constant operation, and every body is seeking to change every other body within the range of its influence into an image of itself. These emitted energies vary. Some are general, like those of heat. Others are characteristic. The degree of leverage exerted depends upon the degree of special modification in the emitted energies. Through this assimilating influence, and the counter influence of opposing energies, and of innate forces, bodies are organized.

But the influence produced by this leverage depends upon the mobility of the body acted upon. Some are rigidly centralized and vigorously resist change. Others readily yield. Some are peculiarly mobile, and may vary in condition under every impress of special energy from without, assuming some degree of similarity to the emitting bodies. In this mobility, or sensitiveness, the mental organism impresses us as far beyond any other condition of substance in nature, and therefore as peculiarly adapted to respond and vary into conditions of organization in conformity with those of the bodies acting upon it. And its power of retaining these impressions is so excessive that it is capable of receiving them in countless numbers, with little or no obliteration of those formerly received.

But this conception of the leverage of energies upon the mind and its faint resistance, leads directly to the conclusion that the mental organism is becoming, in an exact sense, a reproduced copy of external nature. The conditions of all bodies are merely arrangements of matter under the influence of innate energies. The energy is the essential constituent of condition, the matter only its inessential basis. Any substance which accepts these

modes of energy necessarily assumes similar conditions. The combination of energy without produces an equivalent combination of energy within, and the mind takes on characteristics of organization resembling those of the bodies acting upon it, precisely as the photographic plate may be said to assume surface characteristics resembling those of the bodies to whose emitted energies it has been exposed.

And this modifying influence is not exerted solely during the life of the individual, but is also an element in the hereditary conditions of the organism. It has been exerted throughout the whole phylogenetic development of the individual. The leverage of external energy is not exerted upon each mind separately to the production of changes in an original rigid substratum, but this substratum itself has been organized under the influence of such energies, from its origin in the earliest germ of psychical existence, becoming steadily more complex under the incessant play upon it of the energies of the universe. It seems to follow as a necessary consequence that our conceptions of nature must represent actual conditions, and that the whole mental organism, down to its inmost center, has been molded by external nature, and is an exact reproduction of nature to the extent that it has come into contact with it.

But this only represents the mental conditions in part. The mind has some directive control of its own forces. These interact, combination of mental conditions takes place, and results arise which have no counterpart in external nature. These, in their turn, exert a leverage on external substance, and forms are produced which exactly represent the ideal products of the mind. The mind molds nature into its own image.[1] This mental com-

[1] The molding influence of the mind upon outer nature, through the reproduction in matter of its ideal images, has a parallel in the influence exerted by the mind upon the body. We are all aware how the facial expression comes to indicate the character of the mind, and varies in accordance with mental variations. The mind has also a remarkable leverage upon the body in the cure or the production of diseases. Disease has frequently been cured by remedies which could not possibly have had any influence, simply through mental faith in their efficacy, and death has followed a mental image of mortal injury, as in the celebrated case of the fictitious bleeding of a French criminal. Very marked instances are those of the appearance of the stigmata, or the wounds of the crucifixion, in the case of St. Francis d'Assisi, and several later zealots, apparently through long mental dwelling upon the idea of the crucifixion. The credibility of these is accepted as probable by good authorities, and the ulcerous effect ascribed to mental influence on the capillary circulation through the vaso-motor centers. See "Influence of the mind upon the body in health and disease," by D. H. Luke, M. D.

bination of energies is a process which has its analogue in the outer world. Similar combinations take place in objects, and the energies received from without combine with those within to produce new conditions. If the mind has a substantial basis it must conform, in every respect, to the principles which display themselves in external compounds of substance. Yet in this respect the mind seems to be peculiarly active. The objects of the outer world consist of a dense aggregate of matter affected by a limited volume of energy. As all change is due to the interaction of this energy, external objects vary but slowly and slightly, sluggishly resisting its action. In the case of the mind we may conceive its substance to be reduced to a minimum and its energy enhanced to a maximum. Thus its mobility is extreme, its sensitiveness excessive, its interactions of energy rapid and incessant. Its powers of change and of new formation of conditions are vast as compared with those of physical objects.

And the molding of the mind of man by nature is but slightly due to its direct sensations from external objects. It is very largely produced through the medium of other minds, since a leverage exists between mind and mind as between mind and matter in producing conformity of conditions. In this indirect way a single mind may have been brought into conformity with outer nature through the intermediate influence of millions of other minds, exercised through the preservation of their ideas in books, or through their effects upon human society.

We may close here with a brief consideration of the status of the human mind if its development could be continued to infinity. In such a case it would necessarily become an infinitely complete reproduction or representation of the universe, and infinitely sensitive and mobile to any modifications taking place in the vast domain of space. In the second place, it would be infinitely capable of producing within itself new combinations of energy. It would thus be far more than an image of the universe, since to this it would add a second universe of self-formed ideas. In the third place, it would be infinitely capable of reproducing these ideas in outer nature, and thus bringing the universe into conformity with itself. Man's powers in this respect are limited, yet without changing place he has, by availing himself of the motor principles and physical conditions of nature, a very extended reach. As one example, by making the telegraph wire a virtual

extension of his body, he may exert a physical influence many thousand miles away. An infinite mind might possess infinite command of these conditions and principles, and produce effects reaching to the limits of the universe. Fourthly, consciousness would become extraordinarily developed in such a mind, and its whole vast range of memories be present at will. Prevision would have a like extraordinary development. In short, in such a mind all that we include in the name Deity would exist. It would not be the deity of pantheism, the soul of the world, any more than man's mind is the soul of the machine he has devised, and whose motion he controls. The energies of nature would exist separately from those of the deific mind, but they would be mirrored in this mind, and would be infinitely and endlessly subject to its control.

That any developing mind could reach infinity of development is, of course, impossible. If such a being as the one here considered exists, it must be as a co-eternal existence with the universe, a primordial equivalent in conscious of the physical universe in unconscious conditions. Yet consciousness and varying activity could not exist, even in such a deific mind, except through the impulse of energy received from without. Between such a mind and the universe there must be an incessant interchange of energies, with consequent modifications in the condition of each. But the mobility of mental, as compared with the sluggishness of inorganic change, must necessarily make the former the ruling agent. Once in harmonious agreement with external conditions, it would subsequently, by its rapidity of ideal combination or construction, impose constant new conditions upon external nature, and become the sole active moving force in evolution, thinking out the universe, as it were, and embodying all its thoughts in substance. This idea is offered as a curious speculation only, a corollary from the view of the mental constitution above taken, and as a hypothetical contribution to the somewhat extended list of theistical theories extant.

(To be continued.)

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— While regard for human life distinguishes the European branches of the Aryan race, it can learn a good deal from some of the other branches and races in the matter of similar humanity to the lower animals. The destruction of harmless reptiles, almost universal among the less educated members of the white race, is not practiced by some of the others, notably by the Hindoos, who might be readily excused for wholesale extermination, such is the number of venomous species in their country. The kindness of this and other races to the wild Mammalia is well known. In few countries would be practiced, except by boys and savages, the wanton firing on bison from railroad trains, such as was common in this country while that fine animal was still abundant. Few civilized people would disgrace themselves as some of our English visitors formerly did by shooting scores of buffalo which would only walk away from them. It is still a favorite pastime for equally thoughtless "sportsmen" to shoot from steamers in Southern waters that last representative of the great saurians, the alligator.

The destruction of animal life for useful purposes is of course necessary, but here the greatest folly goes hand in hand with the greatest inhumanity. When it is a question of the natural products of the earth, bison, alligators, and in fact almost all wild animals have important economic values, and the intelligent economist will preserve them on this account alone. But it is the custom, in this country at least, to kill the goose that lays the golden egg, and to let the proprietor of sheol take the hindmost. Such is the destruction of fishes by dynamite cartridges, a practice in which none but an idiot could indulge, and which is fortunately punished by severe penalties. The latest case of wanton destruction is the sweeping of our Atlantic coast of surface fishes by the nets towed by the steamers of the U. S. Menhaden Oil and Guano Association. According to the statistics gathered by the investigating committee of the Senate of New Jersey, 450,000,000 of menhaden were captured during the year 1881, and 350,000,000 during 1882, and so on, and with them an enormous number of mackerel, blue-fish, weak-fish, etc. From one of the steamers 70,000 lbs. of food fishes were purchased in thirty days.

The testimony of all classes of fishermen shows that nearly all species of food fishes have been more than decimated by the operations of this company during a very few years. Here is a case where legislation is needed on behalf of the economic interests of fish consumers, and it is to be hoped that Senator Sewell's bill will receive due attention from Congress, and that the United States Fish Commission may become the executors of a stringent law. The destruction of menhaden alone should also be restricted, since that means the extinction of a large number of marine animals which live on them, mediately or immediately.

There is a surprising shortsightedness in all these methods of destroying animal life which is not characteristic of the best representatives of our race. In general, animal products stored in the earth will be found to be more extensive and more inexhaustible sources of supply than the bodies of the existing animals themselves. It would be better to let animals live and continue their beneficent function of filling the earth with valuable fertilizers, oils, etc., than to destroy the supply at its fountain-head. Moreover, the destruction of a great many apparently useless land animals leaves the earth at the mercy of insects, whose countless hordes mankind cannot successfully overcome. And who knows how many still more insidious foes are let loose by disturbing too much the balance of life.

—— At the fourteenth meeting of the French Association, which was held at Grenoble in August last, M. de Mortillet reaffirmed his belief in the existence of man in the Tertiary period. He, however, said that the question was not to know if man as he exists at the present day already existed in the Tertiary period. Animals certainly varied from one geological stratum to another, and these variations increased as the strata were geologically distant. The higher the animals the greater the variation. It was to be inferred, then, that man would vary more rapidly than the other mammals. The problem, he said, as reported by *Nature*, was not to discover existing man in the Tertiary period, but only to find there an ancestral form of man, a predecessor of the man of historical times. The question was, Do there exist in the Tertiary strata objects which imply the existence of an intelligent being? He had no hesitation in saying there do. These objects have, in fact, been found at two different stages of the Tertiary period—in the Lower Tertiary at Thenay and in the Upper Tertiary at Otta; in Portugal and at Puy Courny in Cantal. These objects proved that at these two epochs there existed in Europe animals acquainted with the use of fire, and able, more or less, to cut stone. During the Tertiary period there existed, then, animals less intelligent than existing man but more intelligent than existing apes. This animal, to which M. Mortillet gives the name of Anthropithecus or ape-man, was, he maintains, an an-

cestral form of historic man, whose skeleton has not yet been discovered, but who has made himself known to us in the clearest manner by his works. A number of flints were exhibited from the strata in question which had been intentionally chipped and exposed to fire.

It appears that M. Mortillet carried his audience along with him, for after a long discussion the almost unanimous opinion was expressed, "that after this meeting and discussion at Grenoble, there can no longer be a doubt of the existence in the Tertiary period of an ancestral form of man!"

It is to be doubted, however, whether the slight amount of evidence which leaves no doubt in the minds of the French anthropologists will be altogether satisfactory to some of the doubting Thomases in this line of study. We shall want to examine the skull and bones, and other more conclusive evidences of human or semihuman art than those as yet discovered. Until then the truly cautious and scientific mind will hold itself in suspense.

—— The desirability of State aid to scientific research is not only deducible from the importance of the exposition of the economic resources of a country, but from the necessity of sustaining its educational interests and progress. It is well-known that some branches of scientific research are too expensive to be carried on by private individuals, excepting those of the greatest wealth, and that such persons are very rarely interested in science. Our neighbors of the Republic of Mexico are following in our own footsteps, in this respect, in the establishment of a Comision Cientifica. This body is composed of the most learned men selected from all parts of the country, and is under the presidency of Dr. Fernando Ferrari-Perez of Puebla. Its object is research in every department of human knowledge. It is making extensive collections of all the natural products of the country, and will be, as we anticipate, of great advantage to the best interests of Mexico.

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RECENT LITERATURE.

WHITE'S REVIEW OF THE FOSSIL OYSTERS OF NORTH AMERICA.[1] —This memoir is designed rather as a general review than a revision of our fossil oysters, and is addressed to the general reader. The oldest oysters, as is well known, occur in the Carboniferous rocks and belong to the genus Ostrea; while Exogyra and Gryphæa are of Jurassic age, but culminated with the genuine oysters in the Cretaceous period; the family abounded more in

[1] *Department of the Interior, U. S. Geological Survey*, J. W. Powell, Director. A Review of the fossil Ostreidæ of North America, and a comparison of the fossil with the living forms. By CHARLES A. WHITE, M.D., with appendices by Professor ANGELO HEILPRIN and Mr. JOHN A. RYDER. Extract from the fourth annual report of the Director, 1882–1883. Washington, 1884. Large 8vo, pp. 279–333, Pls. 34–82.

the Tertiary than the present age. It is melancholy to think what multitudes of these delicious bivalves lived and died, from a gastronomical point of view, in vain, with no human beings to appreciate them, unless Mortillet's Tertiary ape-man preferred oysters to tender roasts of his own species, for Dr. White assures us that the Mesozoic oyster was as good eating as those of the present day.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

GENERAL.—The Royal Geographical Society have adopted in the spelling of geographical names a set of rules, the general use of which will do much to avoid the present confusion. Familiar names, such as Calcutta, Celebes, Mecca, etc., will be retained in their present form, but with these exceptions foreign names in countries which use Roman letters will be spelled as by the respective nations. The true sound of the word as locally pronounced will be taken as the basis of the spelling, but only an approximation will be aimed at, no attempt will be made to represent the more delicate inflections of sound and accent. The vowels will be pronounced as in Italian, and the consonants as in English; every letter will be pronounced, and the only accent used will be the acute, placed upon the syllable on which stress is laid. Indian names (East Indian) are accepted as spelled in Hunter's Gazetteer. Thus: Fiji and Zulu are accepted spellings, not Feejee and Zooloo. All vowels are shortened in sound by doubling the following consonant, and the doubling of a vowel is only necessary when there is a distinct repetition of the single sound, as in Oosima. Au is to be pronounced ow as in how, thus Fuchau, not Foochow, is to be written. The sound of English f will be represented by that letter, not by ph, thus, Haifong not Haiphong. G is always hard, soft g is written j; h is always pronounced when inserted, and Dj must not be written for the sound of j. K is to be written for hard c, thus, Korea not Corea; the oriental gutturals kh and gh will be used; kw will be used for qu (Kwangtung), and y is always a consonant, and should therefore never be used at the end of a word.

AFRICA.—*M. Foucauld's Travels in Morocco.*—M. Charles de Foucauld accomplished during 1883 and 1884 a remarkable journey of exploration in Morocco. Renouncing his prospects in the military career, he disguised himself as a Jew, concealing his barometer and sextant under the long veil with which the Jew covers himself during prayer. Without servants, tent or bed, without baggage or horse, he traveled and worked eleven months among people who, had they unmasked him, would have killed him as they have others. Little was known of the geography of Morocco before his journey. The first map of the country on the scale of 1 : 2,000,000 was drawn up in 1845 by M. Emilien Renou. Three years afterwards this was revised by Capt. Baudouin, and the scale increased to 1 : 1,500,000. To the 7600 miles of roads marked out, with but few determinations of latitude and still fewer of longitude, M. de Foucauld had added 1400 miles of new ground, besides revising and perfecting the

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

work of his predecessors. From Cape Guir or Ghir to the Algerian frontier the length of the great Atlas range was known to be 435 miles, but only four points had been determined by previous itineraries. M. de Foucauld crossed the chain at several new points, of which he determined the altitude, besides journeying 185 miles along the base of the range, studying the orography of the country. The main range is flanked by parallel lines of elevation. There is in the north a chain of mountains 185 miles long, which bears the names of Djebel-Ait-Seri and Djebel-Beni-Uaghain, and in the south there is first of all the Little Atlas, and further south the strange outline of the Djebel-Bani range. In Dec., 1883, M. Foucauld touched the Wady Dhrâ'a to the south of Tattas. It was dry. Later on he saw it further to the north-east, in the district of Mezquita, where it flows through plantations of date-palms. The part of this river indicated on Dr. Rohlfs' maps is by M. de Foucauld placed one degree further west. M. H. Duveyrier, the writer of the report of M. Foucauld's journey, is now traveling in Morocco.

African News.—The Rev. G. Grenfell has contributed to the Royal Geographical Society a chart of the Mobangi, which proves to be a great navigable stream, flowing nearly from north to south across the blank on our present maps of Africa between the sources of the Benue and Shari to the Congo. Mr. Grenfell ascended this river from its junction with the Congo, in a delta extending from 26 to 42 minutes south of the equator, to 4° 27′ N. latitude. Throughout the whole district it is a magnificent stream, with a mean depth of twenty-five feet, and at the furthest point it was still an open water-way. The country around is richly wooded and seems fertile, and the banks are more densely populated than those of the Congo. It is full of islands.——Professor Ratzel, in Petermann's Mitteilungen for July, seeks to show how misleading it is to color a map of Africa with definite political boundaries. The state of culture in Africa is as varied as the ethnology, and these stages of culture are the prime element in the so-called political geography of Africa. Professor Ratzel divides Africa into twelve "State-forming" peoples, under the two great sections of North African and Soudan States, and Negro States.——Dr. Mannington, bishop of Equatorial Africa, has attached himself to a Swahili caravan to explore a route, different to that followed by Mr. Jos. Thomson, via Chagga and the Masai country, to the eastern shores of Victoria Nyanza.——Some Swedish merchants have purchased a tract of land in the Cameroons, and have established a considerable trade with the natives.——Sig. Buonfanti has published a reply to the doubts of Herr G. A. Krause respecting his journey across the Sahara and Western Sudan to Guinea. The writer's letter to the Bolletini of the Italian Geographical Society is dated May 6th, on board

the *Corisco* at Banana. Documentary proofs of his trip, including translations of safe-conducts and firmans from the sultans of Bornu and Socoto, etc., are, he says, under lock and key at Brussels, and will, with the originals, be produced. Herr Krause heard nothing of his movements, because he did not reach the coast there, but at Portonuovo, some forty-five miles further west. Nothing was heard of him in the Yoruba country, because he passed 200 miles to the east of it.——The African travelers, Yuncker and Casati, are, according to a telegram received in Berlin, at Lado, an Egyptian military post on the Bahr-el-Jebel.——M. Coudreau has, as one of the results of his six journeys in Guiana, brought back materials for two new maps, the one of the region between the Oyapock, Yari, Amazons, and Atlantic, the other of Southern Guiana between the Branco and Paru.——M. Ballay, at the meeting of the Geographical Society of Paris, on April 25th, gave an account of his journey with two canoes (in sections) to the Alima from the Upper Ogowé. The intervening region is an arid steppe strewn with human remains. He established a peace with the Apfurus.——M. Leon Guiral has sent to the Geographical Society at Paris, a description of the west coast of Africa about the mouths of the San Benito or Eyo and the Dote, 7½ miles further south. The Eyo is a mile in width at its mouth. Banks of rocks bar the entrance, but the left arm is navigable for vessels drawing two meters of water. The banks are marshy. M. Guiral ascended it about thirty kilometers, to Iniger, where there are falls. It has several tributaries, some of them navigable for canoes. The Dote is a river of little importance, with marshy banks, and is about a meter deep and forty meters wide along the lower part of its course. It can be ascended in a canoe for about twenty-one miles. The commerce of the district concentrates in the village on the right bank from which it takes its name. The natives are tall and are good canoe-men, but given to brandy.——The death of Mirambo, in December last, is confirmed; it was followed in January by that of Kapura, his principal adversary.——The International Association has handed over Karuma and Mpala to the Algerian missionaries, who previously possessed five establishments in the region of the Great Lakes. ——The protectorate of France now extends along the whole north coast of the Gulf of Tadjura as far as Bahr-Assal, and M. Caspari states that the relations of France with the Danakils are cordial. Obock is at least a safe and easily accessible harbor, and the abundance of water renders possible the cultivation of vegetables.——The German East African Expedition, commenced five years ago, has now been brought to a close, and Herr Paul Reichard, its only survivor, has probably by this time reached Zanzibar. Dr. Bohm and Herr Reichard crossed the Luapula into Urua, where the former died. After his death his companion ascended the Lufira as far as the famous copper

mines of Katanga. The wide region lying between the Lualaba, Urna, the Kande Irunde mountains, and Iramba, is governed by a powerful chief called Msirri. The Lualaba bounds his dominions on the west, and is a considerable river, 400 to 600 yards wide where Herr Reichard saw it, and navigable as far as Manyuema This river, which from its volume must be looked upon as the real head of the Congo, flows through Lake Upemba. The Lufira, which is tributary to it, flows through the center of the country. It rises twenty days' journey to the south of Katanga. Katanga, the exceedingly rich copper mines of which are at present unworked, is about 250 miles south-west of Luapula, and forms part of Msirri's dominions.

AMERICA.—*American News.*—In the August number of the Proceedings of the Royal Geographical Society, Mr. E. im Thurn gives a full account of the difficulties incurred in the journey to and ascent of Roraima, as well as of the botanical rewards obtained. The general aspect of all the plants on the summit is dwarf, almost alpine, but many lovely flowering plants, including one closely resembling the crown imperial, and a luxuriant pitcher-plant (Heliamphora) occurred, with a few ferns and one shrub five or six feet high. The top of the mountain is not flat, but forms a shallow basin, the edge formed by the rugged edge of the cliff. This basin is divided up into a vast number of smaller shallow basins, separated by curiously terraced ridges of rock, often of crescentic or even ring-like shape. These basins hold a quantity of water, and every shower of rain suffices to swell the water to such an extent that cascades fall over the cliff. Sir Robert Schomburgk states that the water seems to flow, not from the top of the cliff, but from points some distance below. This is readily explained, for it flows through deep and narrow sloping channels, often cut parallel with the face of the cliff and hidden by projecting promontories. The statement of previous travelers which Mr. Im Thurn found hardest to explain was that the top is covered with trees. This has been made with reference to the southern end, where there are certainly none, and our traveler believes that the rugged pinnacles and points of rock have been mistaken for trees.——M. Chaffanjon, writing from Ciudad Bolivar, in May, states that with two Ariqua Indians he passed up the Caura river to its source, and obtained a mass of curious information respecting the manners and religious beliefs of the Arebatas, Penares and other tribes. He was also able to visit and study the Yaruras and Mapayes. His explorations on the Orinoco have enabled him to rectify many errors in the charts of its course.——Dr. Finsch is returning to Europe from his recent exploring expedition along the unknown portions of Kaiser Wilhelmsland, which are situated between Astrolabe bay and Humboldt bay. He reports the discovery of several good harbors and of a navigable river. The natives were friendly.

ASIA.—*Asiatic News.*—Sibiriakoff, the friend and patron of Nordenskjold, during the summer of 1884 ascended the Petchora to Oromets, then crossed the Ural to the Sigva or Whitefish river, which flows in the Sosva affluent of the Obi, and reached Shikurik Sept. 2. The journey demonstrates that a trade route is open in this direction in summer.——Cols. Lockhart and Woodthorpe have been despatched with a party to Gilghit, and it is intended that full surveys of the region lying to the north-west of Kashmir shall be executed. Several passes of no great difficulty here lead towards the Russian possessions, which approach closely.——Colonel Woodthorpe has just completed a journey through the Singpho country. He penetrated into the land of the Bor Khamptis on the northern Irawadi, where no traveler is believed to have been since Lieutenant Wilcox's tour in 1828. Several mines lie north-east of Pedan, the capital, and are worked by an inferior and half-subject race called Khanungs. The Irawadi is unnavigable at Pedan.——The journeys of Dr. Neis in Central Taos (more than 3000 miles) have resulted in a vast amount of information regarding the commercial routes of the western basin of the Mekong, the anthropology and ethnology of the Laos and the Khas, and the social, commercial and political condition of the regions visited.

EUROPE.—*European News.*—Recent examination of bench marks made in 1851 along the Swedish coast of the Baltic show that the movement of elevation was continued in the north, and that of depression in the south of the Scandinavian peninsula. Compared with previous observations, the results prove that since 1750 the head of the Gulf of Bothnia has risen 2.10 meters. About Calmar and Carlscrona no change of level could be detected, but the general result is an elevation of the Swedish coast at the mean rate of 1.60 meter per century.——Four arctic expeditions are said to be projected for next year. Holland will send one, Denmark one and Portugal, newly awakened, it would appear, to the love of discovery, will send two. All propose to visit the Russian islands of the glacial ocean, but the Danish expedition will specially explore the Kara sea, to define as far as possible the unknown region which is supposed to lie to the north-east of Novaya Zemlya.——The captains of several Norwegian steamers despatched to Greenland for seal-hunting, report that the east and south coasts are so obstructed by ice that no seals have been killed.——The population of Iceland in 1880 was 72,445, all of whom were Lutherans, except 3 Mormons, 1 Catholic, 1 Unitarian, 1 Methodist and 3 of no religion in particular.

GEOLOGY AND PALÆONTOLOGY.

ON THE PRESENCE OF ZONES OF CERTAIN SILICATES ABOUT THE OLIVINE OCCURRING IN ANORTHOSITE ROCKS FROM THE RIVER SAGUENAY.—While engaged during the summer of 1884

in making a geological examination of a portion of what has proved to be a very extensive area of anorthosite rocks, which belong to what has been called the Norian or Labrador series, occurring about Lake St. John and the Upper Saguenay, and which from thence strikes far away to the north, I noticed in many of these rocks a mineral which weathered to an orange color and which, when the weathered surface of a specimen containing it was carefully examined, was invariably seen to be surrounded by a narrow light green border. On my return to Ottawa in the fall a large number of thin sections of these rocks were prepared and were found on examination to exhibit a most interesting phenomenon, which I propose here to describe briefly.

The mineral olivine has never heretofore been mentioned as occurring in the Norian series in Canada, although Dr. Hunt, I believe, has mentioned it as a constituent of certain boulders of anorthosite rock, referable to this series, which were found in New Hampshire, but which were probably carried thither from Canada during the glacial age. The mineral, however, occurs abundantly in the anorthosite of many parts of the Saguenay area, and I have also found it in a specimen from a little area of rocks which has been referred to this series, and which occurs near Dolin's lake, in New Brunswick.

When thin sections of the massive or nearly massive dark violet anorthosite from the shore of Lake St. John, near the Little Discharge of the Saguenay, is examined with the microscope, the rock is found to be composed of plagioclase, olivine and iron ore. The plagioclase occurs in large well twinned individuals, which are seldom broken or twisted, and which between crossed trichols show nothing of the peculiar, wavy appearance so often seen in the feldspar of the Laurentian gneiss. The iron ore which is present only in small amount is probably titaniferous, as in one slide a grain of it is seen partially altered to leucoxene. The olivine, of which the rock usually contains a large quantity, occurs either in single individuals, or especially in the larger grains, as several individuals united to form one grain. They seldom have any resemblance to proper crystalline forms, but one usually irregular in shape, a single individual sometimes forming a very irregular elongated string. It is recognized by its bianial character, high index of refraction and imperfect cleavage, and although like the plagioclase very fresh, by the presence of a little serpentine which here and there may be detected along the cracks which traverse it. The olivine, as is usually the case in eruptive rocks, crystallized before the plagioclase and therefore lies imbedded in it; but although I have examined a very large number of thin sections of this rock, I have never been able to find these two minerals in contact, there being invariably two zones of certain other silicates surrounding the olivine and intervening between it and the plagioclase, so that since the rock consists almost entirely of these

two minerals, every grain of olivine is seen to be completely surrounded by this double zone.

The zone, next to the olivine, is colorless, or nearly so, but often shows a slight pleochroism with reddish and greenish tints. It is formed of small individuals grown compactly together and considerably elongated in a direction at right angles to the surface of the olivine. When examined with a high power the mineral is seen to possess two sets of imperfect cleavages, and when these cross one another at right angles, the direction of extinction bisects the right angle. When cut perpendicular to an optic axis, it shows the revolving bar of a biaxial crystal.

The second zone, or that next to the plagioclase, forms a fringe about the zone just described and consists of minute needles of a light green fibrous mineral arranged at right angles to the surface of the inner zone and penetrating into the plagioclase, so that their examination is attended with considerable difficulty. They are, however, seen to be slightly pleochroic with different shades of green and to have an extinction which makes a small angle with the length of the fibers. It has exactly the appearance of actinolite, as that mineral is generally seen in thin sections, and that it is really a variety of hornblende is proved by the fact that in another specimen of the same rock collected a few miles away, in which the zones are still seen in all their perfection, the outer one is no longer fibrous, but shows the cleavage and absorption characteristic of hornblende.

The olivine and the minerals composing the two zones are entirely differently orientated, and the breadth of the zones does not bear any absolutely constant relation to the size of the olivine grain as seen in the slide, since this latter would vary greatly, according to the direction in which the section passed through it. The inner zone, however, is always smaller than the outer one.

Although the mineral forming the inner zone has the characters of a pyroxene, no conclusive evidence as to its nature could be obtained from the sections of this rock. Similar double zones are, however, found about the olivine in rocks from other parts of the area having the individuals of the inner zone better developed. In these the pleochroism and rude cleavage are very distinct. In a section of one of these rocks a grain of pyroxene exactly resembling the mineral of the inner zone, but not associated with the olivine, was so cut that it could be proved to be a rhombic pyroxene, in that on a basal section known by the cleavages being at right angles a bisectrix could be seen. It may therefore be said that the inner zone is *probably* composed of a rhombic pyroxene, while the outer one is certainly hornblende.

Positive information respecting the nature of the mineral forming the inner zone can only be obtained by separating some of it by means of a heavy solution and examining the powder so obtained. This I propose to attempt, and will make known the

result in a paper on these rocks which is now in course of preparation.

Although these zones have been mentioned by three or four writers, Dr. Törnebohm, who first observed them in certain gabbros from Sweden (Neues Jahrbuch für Mineralogie, &c., 1877, p. 383), is, so far as I am aware, the only one who has described them. Owing to the kindness of that gentleman I have had an opportunity of examining thin sections of a number of these Swedish rocks. The double zone is well seen in them, but is much smaller than in the Canadian rocks, and the minerals composing it accordingly more difficult to determine. Dr. Törnebohm, although unable from his sections to determine the nature of the inner zone, rightly regarded the outer one as hornblende.

The chief interest attached to these zones arises from the fact that, as Törnebohm remarks, they appear to have originated from a mutual reaction between the olivine and the plagioclase. An examination of the thin sections of the Saguenay rock impresses one strongly with the conviction that they have resulted from the action of the molten plagioclase magma on the olivine grains, which in eruptive rocks always separate out before the plagioclase, thus having an origin similar to the kelyphite zones about pyrope described by Schrauf, and somewhat analagous to the zones about olivine and hornblende in volcanic rocks, which have recently attracted so much attention. The subject is one of importance as indicative of the processes at work in the genesis of rocks, and also as throwing some light on the much discussed question of the origin of these anorthosite rocks.—*Frank D. Adams, Geological Survey of Canada.*

Eocene Paddle-fish and Gonorhynchidæ.—The Polyodontidæ or paddle-fish are only known from the American and Chinese rivers, and no trace of them has been found hitherto in the records of earlier periods of time. It is therefore of much interest to zoölogy that I am able to announce the existence of remains of a species of this family in the Eocene Green River shales of Wyoming Territory. This determination is based on a skull, of which one side is fairly well preserved, of an individual of the size of a middle-aged specimen of the common paddle-fish (*Polyodon folium*). The long snout is somewhat damaged, but was less dilated than in that species, being intermediate in character between the snouts of the American and Chinese forms (*Psephurus gladius*). The stellate bones are smaller and more attenuated than in the *P. folium*, and the gape of the mouth is not quite so wide. The symphyseal bone, enclosing Meckel's cartilage behind, is much smaller. There is a bone in contact with the front of the operculum below, which may be one of two or three elements, which is apparently not present in Polyodon, at least not in that position. For this reason I propose to distinguish this fish generically

from Polyodon. The probable body of this species was described in the NATURALIST, 1883, p. 1152, under the name of *Crossopholis magnicaudatus* Cope.

While the preceding species fixes the age of a type distinctively of the northern hemisphere, I have to add another to those which testify with equal certainty to the presence of southern hemisphere forms as present in North American waters during the Eocene period. This is a member of the family of the Gonorhynchidæ, a group which is now confined to the southern parts of Africa, and to Australia. The species, which is represented in my collection by two fine specimens, is about as large as a fully grown pickerel, but of more slender proportions. The head is short and the mouth small and edentulous. In its generic characters it agrees generally with Gonorhynchus, but differs in the absence of prominent hyoid and pterygoid teeth. The scales are broadly fringed at the margin, like those of the cotemporary genus of Aphredodiridæ, Amphiplaga, and the Trichophanes of the Amyzon beds. The dorsal and anal fins are posterior and opposite. Radii, D. I. 13; V. 8; A. II. 8. Vertebræ Ab. 34 C. 14½. Depth six and three-quarters times in length; head six and a half times in length. The genus and species may be called *Notogoneus osculus.*

A survey of the fish-fauna of the Green River shales yields the following results: Of North American existing fresh-water types we now have represented Lepidosteidæ, Polyodontidæ, Aphododeridæ and Percidæ. Of southern hemisphere types, Gonorhynchidæ and Osteoglossidæ.—*E. D. Cope.*

A CRITIQUE OF CROLL'S GLACIAL THEORY.—A paper before the Geological section of the British Association, by W. F. Stanley, F.G.S., had the following points: The theory of Dr. Croll, accepted by many geologists, is that former glacial periods in the northern hemisphere were due to greater eccentricity of the earth's orbit and to this hemisphere being at the time of glaciation in winter perihelion. This theory is supported upon conditions that are stated to rule approximately at the present time in the southern hemisphere, which is assumed to be the colder. Recent researches by Ferrel and Dr. Hann, with the aid of temperature observations taken by the recent transit of Venus expeditions, have shown that the mean temperature of the southern hemisphere is equal to, if not higher, than the northern, the proportions being 15.4 southern, 15.3 northern. The conditions that rule in the south at the present time are a limited frozen area about the south pole not exceeding the sixtieth parallel of latitude, whereas in the north frozen ground in certain districts, as in Siberia and Northwestern Canada, extends beyond the fiftieth parallel; therefore, by comparison, the north, as regards the latitude in which Great Britain is situated, is at present the most

glaciated hemisphere. As it is very difficult to conceive that the earth had at any former period a lower initial temperature, or that the sun possessed less heating power, glaciation in the north could never have depended upon the conditions argued in Dr. Croll's theory. The author suggested that glaciation within latitudes between 40° and 60° was probably at all periods a local phenomenon depending upon the direction taken by aërial and oceanic currents, as, for instance, Greenland is at present glaciated. Norway has a mild climate in the same latitude, the one being situated in the predominating northern Atlantic currents, the other in the southern. Certain physical changes suggested in the distribution of land would reverse these conditions and render Greenland the warmer climate, Norway the colder.

Occurrence of a deep-sea Foraminifer in Australian Miocene Rocks.—At the meeting of the Royal Society of South Australia, on June 2, Mr. W. Howchin, F.G.S., exhibited a specimen of *Astrorhiza angulosa* as a fossil found in the Miocene strata of Victoria. The specimen was stated to be of more than ordinary interest, inasmuch as it was the first instance in which the genus had been found in the fossil condition in the recent slate. The species submitted was very rare, having been hitherto known to occur only at two localities, one of these being at a *Challenger* station to the east of the Azores, at a depth of 1000 fathoms, and the other at a point in the North Atlantic, dredged by the *Porcupine*, at 630 fathoms, where only a single specimen was taken. There are five species in the genus, but with the exception of a single specimen of an allied species taken by the *Challenger* off the Cape of Good Hope, the genus is only known as a North Atlantic type. The species discovered in the Victorian rocks is one of the rarest; its occurrence, therefore in the fossil condition in the Australian Tertiaries is a matter of some interest. The speaker stated that his researches with regard to the microzoa of the Australian formation led him to believe that many of the rarer arenaceous forms of foraminifera recently discovered in the deep seas, and which have been so beautifully illustrated by Mr. H. B. Brady in the Scientific Results of the *Challenger* Expedition, occurred as fossils in Australian geology from the Cretaceous formation downwards.—*English Mechanic.*

Geological News.—*General.*—Prof. P. M. Duncan has contributed to the Quarterly Journal of the Geological Society an account of the structure of the ambulacra of some fossil genera and species of regular Echini, explaining the effects through generations of crushing upon the characters of the ambulacral plates, and the gradual formation of complicated ambulacral plates.—According to W. Dames and H. Woodward, some at least of the forms which have been described as Phyllopod-shields, from strata of Silurian, Devonian, and Carboniferous ages, are nothing

more than the opercula of Goniatites. Both agree, however, that for other forms this explanation is, according to our present knowledge, inadmissible. W. Dames, however, asserts that none are phyllopodous in their nature, a dogmatic opinion for which he is taken to task by the English palæontologist. They are, in fact, species of Phyllocarida, and not phyllopods.

Carboniferous.—Since 1878 no less than 1300 specimens of fossil insects have been obtained at Commentry, while all other localities have only furnished about 120 examples. These Commentry insects are remarkably well preserved, many of them being complete, instead of consisting of the wings only, as is often the case with insect remains. M. Ch. Brongniart (Revue Scientifique, 29 Aout, 1885) classifies these carboniferous insects as Orthoptera, Neurorthoptera, Pseudo-neuroptera, and Hemiptera. Among the Orthoptera are fifty specimens of *Dasyleptus lucasi*, an ancestral Thysanouran, and numerous Palæoblattariæ and Palæderidiodea. The Neurorthoptera comprise the order of that name and the Palæodictyoptera; the first with the families Protophasmida and Sthenaropterida, and the second with the families Stenodictyopterida, Hadrobrachypoda, and Platypterida. The wings of *Archæoptilus lucasi* are twenty-five to thirty centimeters long, and those of Eugereon and other Stenodictyopterida are finely netted like those of dragonflies. The Hadrobrachypoda are regarded as ancestral types of the Termites. The Platypterida are entirely new. Their wings are broad, generally rounded at the end, and though morphologically like those of the Protophasmida, differ greatly in the nervation. The nerves are well separated, and the wings colored. Six familes of Pseudo-neuroptera can be distinguished, the Megascopterida, Protodonata, Homothetida, and three others containing the ancestral types of the Ephemeridæ, Perlidæ, and Ascalaphus. The Hemiptera are represented by types of the Fulgoridæ and Cicadidæ.

Cretaceous.—Mr. J. S. Gardner denies the synchronism of a large part of the American Cretaceous with that of England. Whether the former are Cretaceous at all is debatable. The question whether a Cretaceous fauna extended into the Eocene, or an Eocene flora extended back to the Cretaceous is answered by Mr. Gardner in these words: "In support of the first proposition we have the innumerable survivals of old types at the present day, wherever the struggle for existence has been less severe, and the fact that the Cretaceous-looking types are largely mingled with others of a Tertiary facies. The Tertiary facies of the flora, on the other hand, is not diminished by the presence of any distinctly Cretaceous plants. I think all the evidence I have been able to bring forward is in favor of a newer rather than an older date, and this is decidedly more in harmony with the march of evolution."——Mr. J. S. Gardner (Quart. Jour.

Geol. Soc., Feb., 1884) describes the British Cretaceous Nuculidæ. Palæontology bears out the separation of the Nuculæ and Ledæ from the Arcidæ. He recognizes fifteen species of Nucula in the limits treated, ten of the group of Ovatæ, the remainder of the group Angulatæ. The Ledæ are ten in number. *Nucula meyeri*, *Nucula gaultina* and *Leda seeleyi* are new species.

Tertiary.—The third part of M. Gosselet's geological sketch of the north of France and the adjoining countries contain sixteen plates, and treats of the Tertiary period, which is divided into Eocene, Oligocene and Neogene. The following are enumerated as "Pretertiary continental formations": Vegetable soil (loam with lignite in its upper bed). flint conglomerate (sand with beneath it clay with flints), Pretertiary loam (loam, plastic clay and sand) and transported Pretertiary deposits. The Eocene is divided into Montian, Landenian, Ypresian and Parisian, the last characterized by *Rostellaria ampla*, *Nummulites lævigata* and *variolaria*, *Ditrupa strangulata*, and its glauconitic zone by *Pecten corneus*. In the Eocene of Northern France the only vertebrates known are *Arctocyon primævus* and *Pachynolophus maldani*, but the Oligocene has yielded Anthracotherium and many birds, also *Crassitherium robustum*, allied to Rhytina. M. Gosselet divides the Oligocene into Tongrian (principally marls and sands) and Rupelian (Beauce limestone). The Neogene is represented in Northern France and Belgium only by its upper or Pliocene beds.——The description of chilostomatous Bryozoa from Aldinga and the Murray Cliffs, S. Australia, by A. W. Waters, is still continued in the quarterly journal of the Geological Society. The number of fossil species now known is 220, just about half of which have been found living. They are principally from the Tertiary, but a few are Cretaceous.——E. T. Newton (*Geo. Mag.*, Aug., 1885,) describes some bones of a gigantic bird obtained from the Lower Eocene at Croydon, Eng. The most interesting portions are two large tibiæ-tarsi and parts of a femur. These bones very closely resemble the corresponding parts of *Gastornis parisiensis*, but present specific differences. The bird, which must have been as large and heavy in build as the *Dinornis crassus* of New Zealand, has been named *G. klaasenii* in honor of its discoverer, Mr. H. M. Klaasen.

Recent.—The two articles of Prof. J. D. Dana (*Amer. Journ. of Science*, Aug., Sept., 1885), are an able defence of the until recently almost universally accepted theory of the origin of coral reefs and islands by subsidence. The great number of atolls and barriers in all stages to be found in the deep belt of the Pacific, are shown to be inexplainable upon any other theory, while islands like the Marquesas, though without reefs, yield unmistakable evidence of the wide spread subsidence. The views of Darwin and Dana are shown to be those of men who had a wide

acquaintance with the general phenomena; it is admitted that local elevations occurred, and some of the widely isolated points thus elevated are enumerated, and other explanations of the phenomena are passed under review, but dismissed as either insufficient or actually confirmatory of Darwin's theory. The soundings of Mr. Murray off northern Tahita, showing the rapid increase of depth beyond the forty fathom line until, at a mile from the shore, the slope of the ocean bottom was nearly that of the land, are shown to be exactly in accordance with the subsidence theory. The strongest evidence, derived from the writings of A. Agassiz and the soundings of the *Blake*, points to a great subsidence in the Florida region during the coral reef era, and the elongation of the coral reefs and formation of inner channels now going on by drifting coral sands is shown to be but a part of the sand-beach forming process which is in operation along the entire Atlantic coast of North America, from Long Island southward, and to in no way vitiate the evidence in favor of previous subsidence. The abrasion-solution theory of Semper seems to be negatived by the absence of open channels in the lagoons of the smaller atolls, moreover, instead of small lagoons having the purest waters, it is they which are most choked by coral sands.——Almost perfect skeletons of *Rhytina gigas* have been recently mounted in the National Museum, Washington, and in the British Museum.

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.—*Gerhardite.*—Messrs. Wells and Penfield[2] have described natural crystals of a basic copper nitrate which was first identified by Professor Brush, of New Haven, on specimens of copper ore from the United Verde mines, Jerome, Arizona. The crystals, which belong to the orthorhombic system, are mainly made up of a large series of pyramids and the basal pinacoid. Twelve forms were observed. Color dark green; hardness 2; specific gravity 3.426. Plane of the optic axes is the brachypinacoid; double refraction very strong, negative; pleochroism distinct.

An analysis gave:

H_2O	CuO	N_2O_5
11.26	66.38	22.25

Named after the chemist who first determined the composition of the same compound made artificially. This is the only insoluble nitrate known in nature.

Hanksite.—This name was suggested in May of the present year, by Mr. W. E. Hidden,[3] for an anhydrous sulphato-carbonate

[1] Edited by Dr. Geo. H. Williams, of the Johns Hopkins University, Baltimore.

[2] *American Journal of Science*, July, 1885, p. 50.

[3] Ib., Aug., 1885, p. 133.

of sodium occurring in San Bernardino county, Cal. This mineral was exhibited at the New Orleans exposition as thenardite, but was proven by both a crystallographic and optical examination to crystallize in the hexagonal instead of the orthorhombic system. Chemical analysis by Messrs. Mackintosh and Penfield[1] indicate for the formula of this mineral: $4\,(Na_2SO_4) + Na_2CO_3$, with some admixture of potassium and sodium chlorides. The name was assigned in honor of Professor Henry G. Hanks, State mineralogist of California.

Elpasolite is proposed by Messrs. Cross and Hillebrand[2] for a variety of cryolite in which about two-thirds of the sodium is replaced by potassium. Their analysis gives:

Al	Ca	Mg	K	Na	F	Total
11.32	0.72	0.22	28.93	9.90	46.98	98.08

It was found in small cavities in the massive pachnolite occurring with other minerals of the cryolite group at El Paso county, Colorado.

AMERICAN MINERALS.—The last published bulletin of the U. S. Geology Survey (No. 20) entitled "Contributions to the Mineralogy of the Rocky mountains," by Messrs. C. W. Cross and W. F. Hillebrand, contains much valuable information regarding Colorado minerals. A large portion of the matter has already appeared in the pages of the *American Journal of Science* and of the proceedings of the Colorado Scientific Society, but the republication of these papers with many corrections and additions is very welcome. The first chapter deals with the zeolites which occur in the basalt of Table mountain, near Golden, Colorado. The following species were observed, the order of crystallization being: (1) laumontite (oldest); (2) stilbite; (3) thomsonite; (4) calcite (yellow); (5) stilbite; (6) chabazite; (7) thomsonite; (8) analcite; (9) apophyllite; (10) calcite (colorless); (11) mesolite. Natrolite, scolecite and levynite were also found; but not in associations which warranted certain conclusions regarding their relative ages. The analcite and apophyllite exhibited optical anomalies similar to those observed in these minerals from other localities. Chapter second deals with the minerals occurring near Pike's Peak. These occur in veins and druses of a coarse red granite supposed to be of archæan age. The most interesting of these minerals are members of the cryolite group, of which seven species were identified, viz: (1) cryolite upon which by a study of the lamellæ five different twinning laws were found, *i. e.*, twinning plane ∞P; $\frac{1}{2} P$ (r) $\infty P \frac{-}{\infty}$, $\frac{1}{2}P$ (l) and—$\frac{1}{2}P$ (l); (2) pachnolite; (3) thomsenolite; (4) ralstonite (?); (5) gearksutite to which Flight's "Evigtokite" (vid., NATURALIST, 1885, p. 708) is reckoned; (6) El-

[1] *American Journal of Science*, Aug., 1885, p. 137.

[2] Bulletin U. S. Geol. Surv., No. 20, p. 57.

pasoite (no. sp.); (7) proposite. Phenacite, zircon, topaz, cassiterite, fluorite and several other species also occur in the granite of Pike's Peak, in addition to the common microcline and smoky quartz. Minor investigations on the luster of sanidine in certain rhyolites; on the occurrence of topaz in nevadite; short notes on many observed minerals, including the two new species zunyite and guitermanite, already mentioned in the NATURALIST'S notes, make up the other chapters.

Bulletin No. 12 of the U. S. Geological Survey contains a very interesting study, by Professor E. S. Dana, of "thinolite," a name applied by Mr. Clarence King to an enigmatical calcite pseudomorph which occurs abundantly in the old lake basins of the far West. This mineral was at first considered a pseudomorph after gaylussite; Professor Dana, however, shows that this cannot be the case as the original form was clearly tetragonal. What the chemical composition of the original mineral was, it is impossible to state with certainty, but judging from the analogy of well-know n lead-carbonate pseudomorphs after phosgenite ($PbCO_3 + PbCl_2$), the author thinks it quite probable that the original form may have been a similar double salt with the composition $CaCO_3 + NaCl$[1] or $CaCO_3 + 2NaCl$.

M. S. L. Penfield[1] has described crystals of the rare selenide of mercury, tiemanite, from Marysvale, in southern Utah. They are tetrahedral and closely resemble crystals of sphalerite. Observed forms are $_\infty O _\infty$ (a); $+\frac{O}{2}$ (o); $-\frac{O}{2}$ (ó); $+\frac{505}{2}$ (w) and $+\frac{\frac{7}{3}O\frac{7}{3}}{2}$ (φ) — other indistinct positive hemi-trisoctahedra appear on some crystals as striations. The crystals measure less than 3^{mm} in diameter. They are of a black color with a high metallic luster. Twins parallel to the octahedral face are very common.

The same writer[2] also describes crystals of the allied black sulphide of mercury, metacinnabarite, which has heretofore been generally regarded as amorphous. They come from the Reddington mine, Lake Co., California, and measure as much as 4^{mm} in diameter. This mineral is in all respects isomorphous with tiemanite. Observed forms are $\pm\frac{O}{2}$; $\pm\frac{\frac{3}{2}O\frac{3}{2}}{2}$, $\pm\frac{202}{2}$ and $\frac{\frac{9}{5}O\frac{9}{7}}{2}$ (?).

The intermediate compound, onofrite, Hg (S, Se), is not yet known in distinct crystals, but is doubtless isomorphous with the two minerals mentioned above.

Mr. Penfield[3] has likewise described and figured some interesting analcite crystals from the Phœnix mine in the Lake Superior copper region. They show the usual trisoctahedron, 2O2, with

[1] American Journal of Science, June 1885, p. 449.
[2] Ib. p. 452.
[3] Ib., Aug., 1885, p. 112.

each edge replaced by a reëntrant angle. A microscopic examination of thin sections of these crystals shows that they are divided into four secants with a faint irregular action on polarized light. Very many crystals show a perfect but small trisoctahedron in their center, around which the exterior portion appears to be a secondary growth.

Mr. J. P. Iddings[1] of the U. S. Geological Survey communicates a very interesting account of minute fayalite crystals which occur in the lithophyses of the obsidian and rhyolite in the Yellowstone Park. They are less than 2^{mm} in length, black in color and tabular in habit. The following forms were determined by Mr. Penfield: $\infty P\overline{\infty}$, $\infty P\breve{\infty}$, $\infty P2$, P, $P\overline{\infty}$ and $2P\breve{\infty}$. An analysis by Dr. Gooch gave:

SiO	FeO	MgO
32.41	65.49	2.10

Fayalite has heretofore been known only on artificial slags to which the obsidians of the Yellowstone have a close resemblance.

Messrs. Cross and Iddings[2] describe the wide-spread distribution of the mineral allanite as a rock constituent. The chemical nature of this mineral was determined by an analysis by Hillebrand of material isolated from a biotite porphyrite of the Ten Mile District, Colorado. Crystals of an exactly similar nature were discovered in thin sections of all the more acid varieties of massive rocks from many widely separated localities.

Mr. W. G. Brown[3] gives an account of a quartz-twin found in the soil of Albermarle Co., Va., which closely resembles those long since described by G. Rose from Reichenstein in Silesia. The twinning-plane is, however, regarded by Mr. Brown not as R, but as $-\frac{5}{8}R$, as suggested by Naumann. The same writer[4] describes the occurrence and crystallography of the cassiterite from Irish creek, Rockbridge Co., Va.

Mr. Geo. F. Kunz[5] describes the native antimony and its associations at Prince William, York Co., New Brunswick. The antimony most commonly occurs in rounded or elongated masses having a compact, finely granular texture. More remarkable, however, are coarsely crystalline radiating masses consisting of blades four inches in length and one-eighth of an inch in width. Stibnite and kermesite are the only antimony minerals thus far observed associated with the native metal, although others doubtless occur.

[1] Amer. Jour. of Science, July, 1885, p. 58.
[2] Ib., Aug., 1885, p. 108.
[3] Ib., Sept., 1885, p. 191.
[4] Amer. Chem. Jour., Vol. VI, No. 3.
[5] Amer. Jour. of Science, Oct., 1885, p. 275.

BOTANY.[1]

THE GROWTH OF PLANTS WATERED WITH ACID SOLUTIONS.—In the September and October numbers of the AMERICAN NATURALIST for 1883, the writer published the results of an examination of the effects of watering, with acid solutions, growing plants of the silver-leaf geranium, and he there stated his intention of continuing his experiments in this direction by growing the same plant under similar or identical conditions upon siliceous, feldspathic and calcareous soils. These experiments were made in the summer of 1884, and the results obtained form the substance of this paper.

The conclusion seemed warranted by my previous experiments that the acids had a tendency to increase the ash or mineral ingredients of the plant, and this inference led me to suppose that if the soils used were highly mineralized the deleterious action of the acids upon the plant tissue would be diminished and at the same time the introduction into the plant of mineral substances increased. The soils were prepared and the plants potted about July 1st, the proportion of pulverized mineral in all cases being from twenty-five to thirty per cent of the whole, for the silica common cement sand was used, and the earth was taken from garden mold. The strengths of the acid solutions used were as follows: Of hydrochloric, nitric, sulphuric and carbolic 10^{cc} of the concentrated acid to one liter of water; of oxalic, tartaric, tannic, citric and formic 20^{cc} of the saturated solutions to one liter of water. Ordinary flesh-colored feldspar from granite veins in the gneiss rock of Manhattan island was powdered and used for the feldspathic tests, and dolomitic marble from Westchester county similarly treated and mixed in thoroughly with the mold to make a calcareous soil.

The tables following show the results obtained in all my experiments, including those of 1882. The first set of tables shows the state of leafiness of the plants at different times, and the second the percentage of ash with the weight of the dried plant at the end of the experiment.

Experiment of 1882 with garden mold for soil:

	June 25.	*July 13.*	*Aug. 24.*
Hydrochloric	6 full leaves	6 full leaves	5 full leaves
Nitric	5 "	4 "	2 "
Carbolic	4 "	2 "	none
Formic	4 "	6 "	5 full leaves
Salicylic	6 "	7 "	4 "
Sulphuric	7 "	5 "	2 "
Tartaric	7 "	9 "	9 "
Tannic	6 "	9 "	9 "
Citric	5 "	7 "	7 "
Water	11 "	13 "	17 "

[1] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

Experiments of 1883 with siliceous, feldspathic and calcareous soils:

SILICEOUS.

	July 5.	*July 22.*	*Aug. 16.*	*Sep. 1.*
Hydrochloric	5 leaves	5 leaves	5 leaves	4 leaves
Nitric	6 "	7 "	3 "	4 "
Carbolic	4 "	3 "	0 "	0 "
Sulphuric	4 "	4 "	0 "	0 "
Formic	5 "	6 "	5 "	4 "
Oxalic	5 "	7 "	7 "	6 "
Citric	4 "	6 "	6 "	4 "
Tannic	5 "	6 "	7 "	5 "
Tartaric	5 "	7 "	7 "	5 "
Water	4 "	7 "	6 " + fl.	5 "

FELDSPATHIC.

	July 5.	*July 22.*	*Aug. 16.*	*Sep. 1.*
Hydrochloric	5 leaves	6 leaves	5 leaves	3 leaves
Nitric	3 "	2 "	2 "	2 "
Carbolic	5 "	4 "	3 "	1 "
Sulphuric	4 "	4 "	0 "	0 "
Formic	5 "	5 "	4 "	5 "
Oxalic	3 "	5 "	6 "	6 "
Citric	5 "	7 "	8 "	6 "
Tannic	5 "	7 "	5 "	5 "
Tartaric	4 "	7 "	9 "	6 "
Water	4 "	5 "	6 "	5 "

CALCAREOUS.

	July 5.	*July 22.*	*Aug. 16*	*Aug. 22.*
Hydrochloric	4 leaves	5 leaves	3 leaves	2 leaves
Nitric	4 "	2 "	1 "	0 "
Carbolic	5 "	3 "	2 "	2 "
Sulphuric	4 "	2 "	1 "	0 "
Formic	3 "	4 "	5 "	5 "
Oxalic	5 "	7 "	5 "	6 "
Citric	4 "	5 "	7 "	7 "
Tannic	3 "	5 "	5 "	5 "
Tartaric	5 "	5 "	7 "	5 "
Water	5 "	7 "	7 "	7 "

The condition of the plants in these prepared soils varied materially from that of those grown in 1882 in garden mold. They were much more stunted and did not in the most favorable cases put out as many leaves as those of 1882.

The contrast, however, in leafiness between the plants watered with acids and those treated with water alone is far less marked in the artificial soils than in the case of the same tests in ordinary mold. The tables show this. In both experiments the inorganic acids and carbolic acid acted most deleteriously upon the plants,

while under the application of the dilute organic acids the plants maintained a comparatively vigorous growth.

The relative condition of the plants at the end of the experiment as compared with that at the beginning was nearly the same in both sets of experiments, viz., with the inorganic and carbolic acids they underwent a slow devitalization culminating in the death of the plant, or a very reduced state of health, while with the other acids they apparently resisted their weakening influence more successfully, and while not assisted were but slightly injured by their presence in the soil. The mineralized soils proved uncongenial for the plant, but in this case the plants watered with organic acids and those treated with water showed a very similar if not identical state of health.

However, the conjecture that in the mineralized soils the acid-watered plants would show an increase in ash over the water-plant seems confirmed by the following tables of the results obtained.

Experiment of 1882 with garden mold for soil:

	Wt. dried plant.		*Percentage ash.*
Nitric	0.536	grammes	16.79
Carbolic	0.5135	"	16.60
Formic	0.5535	"	18.15
Salicylic	0.5885	"	17.00
Tannic	0.6975	"	19.80
Tartaric	0.9325	"	14.74
Water	1.1615	"	19.11

Experiments of 1883 with siliceous, feldspathic and calcareous soils:

SILICEOUS.

	Wt. dried plant.		*Percentage ash.*
Hydrochloric	.904 ?	grammes	19.46
Nitric	.932 ?	"	17.36
Carbolic	.532	"	17.48
Sulphuric	.357	"	19.60
Formic	.683	"	20.05
Oxalic	.597	"	21.77
Citric	.521	"	20.92
Tannic	.729	"	19.82
Tartaric	.779	"	19.77
Water	.951	"	20.51

FELDSPATHIC.

	Wt. dried plant.		*Percentage ash.*
Hydrochloric	.6395	grammes	21.50
Nitric	.510	"	22.15
Carbolic	.904	"	14.93
Sulphuric	.400	"	22.00
Formic	.757	"	20,67

FELDSPATHIC.

	Wt. dried plant.	*Percentage ash.*
Oxalic	.7575 grammes.	19.09
Citric	.895 "	19.87
Tannic	1.233 "	16.22
Tartaric	.7875 "	18.92
Water	1.2115 "	16.01

CALCAREOUS.

	Wt. dried plant.	*Percentage ash.*
Hydrochloric	.677 grammes	19.35
Nitric	.543 "	22.30
Carbolic	.692 "	16.18
Sulphuric	.502 "	20.10
Formic	·512 "	22.85
Oxalic	.521 "	23.41
Citric	.783 "	20.24
Tannic	.5985 "	18.13
Tartaric	.732 "	19.26
Water	1.33 "	16.39

With the exception of the plants growing in the siliceous soil the other plants, putting aside the carbolic acid plants whose enfeebled condition barely permitted them to retain their vitality, show a markedly higher percentage of ash over that found in the water plants. It would seem as if the acids had dissolved to some extent the feldspar and dolomite, and permitted the plants to assimilate more of the mineral substances of the soils, but that this action in the siliceous soil had been prevented or retarded by the more insoluble character of its ingredients. Even in the latter instance they approach in their percentage of ash more closely to the water plant than in the experiment made with the unmineralized soil. The varying *special* details of the experiments should not in this connection be made the basis of any general conclusion, as unequal exposure to the flame in reducing the plant to ash gives rise to important differences in the weights of the residual salts. But it is apparently justifiable to conclude that the action of acid upon soil containing growing plants is to increase the mineral constituents of the latter, and that slightly acid waters percolating through a pulverulent soil richly provided with comminuted and impalpable matter would assist its introduction into plants needing these elements.

Professor Stockbridge, in a report to the Board of Agriculture of Connecticut in 1876, says that, "Every plant contains silica, potash, soda, lime, magnesia, phosphoric and sulphuric acids, chlorine and iron, and in order to have soils feed plants the material must be brought into such condition that the vital force can use it." This is of course obvious, and the slow corrosive action of terrestrial waters and falling rains in decomposing the mineral components of soils is doing that very thing. The experiments described and their results are a very exaggerated form of the nat-

ural processes prevalent about us. The plants, though injured in their growth and their consequent powers of absorption, by the quite acid solutions used, showed as high and *higher* percentages of mineral matter in the ash as did the water-fed plants which were unimpeded in their nutritive processes by an injurious treatment. Experiments may now be undertaken upon phosphatic (insoluble phosphate) soils with the same means.—*L. P. Gratacap, New York City.*

Botanical News.—Papers on the following subjects occur in the later numbers of *Annales des Sciences Naturelles*, viz., Characters of the principal families of Gamopetalæ drawn from the anatomy of the leaves, by Julien Vesque; The dissemination of the spores of vascular Cryptogams, by Leclerc du Sablon; Notes on some new or little-known parasitic Fungi, by V. Fayod. In the latter are noticed *Endomyces parasiticus* Fayod, a new species parasitic on the gills of *Agaricus rutilans; Peziza mycetophila* Fayod, another new species parasitic on *Agaricus vellereus;* and *Hypomyces leotiarum* Fayod, parasitic on *Leotia lubrica.*——Late numbers of *Flora* contain the following articles, viz.: New Lichens of Bering's straits, by W. Nylander; New North American species of Arthronia, by W. Nylander; The opening and unrolling of fern sporangia and anthers, by J. Schrodt.——In the last *Hedwigia* Professor Oudemans describes a new species of rust, *Puccinia veronicæ-anagallidis.*——The September *Journal of Mycology* is devoted wholly to a description of the North American species of Glœosporium, forty-seven in all.——In *Grevillia*, M. C. Cooke describes a large number of new British Fungi; and Cooke and Plowright describe twenty California Fungi, including one interesting rust, *Uromyces puncto-striatum*, on twigs of Rhus.——The *Journal of Botany* for September contains a valuable paper on the caulotaxis of British Fumariaceæ, by Thomas Hick; A list of European Carices (151 species), by Dr. H. Christ; and a Classification of garden roses, by J. G. Baker, in which sixty-two species are recognized.——Late numbers of the *Botanische Zeitung* contain papers by Arthur Meyer on the Assimilation-product of the leaves of angiospermous plants, and by Solms-Laubach on the Sexual differences of fig trees.——The most important botanical articles in the September *Gardeners' Monthly* are, The destruction of trees by coal gas, by H. F. Hillenmeyer; The curl in the peach, and The age of yew trees.——Late numbers of the *Gardeners' Chronicle* contain a review of the genus Odontoglossum, by James O'Brien (accompanied with many wood-cuts); a notice of the Chelsea Botanic Garden; The cross-breeding of cereals; Disease and decay in fruit, by W. G. Smith; a notice of the life of Dr. Regel, the venerable director of the Imperial Botanic Garden of St. Petersburg; a description of a new Brazilian species of Aristolochia (*A. elegans*); figures and descriptions of *Peronospora pygmæa* and its resting spores.

ENTOMOLOGY.

ON THE PARASITES OF THE HESSIAN FLY.[1]—The paper consists of a digest of a communication on the same subject now in press in the Proceedings of the U. S. National Museum. It gives the synonymy of *Merisus destructor* (Say), showing the difficulty that has been encountered in the past in properly locating it generically. It then reviews what was known of the habits of the species by earlier authors and, on account of the insufficiency of previous descriptions, gives a full and detailed description. The descriptions of Herrick, Fitch and Packard are shown to refer to this species rather than to any other so far known. The species never occurs in the apterous condition.

Merisus (*Homoporus*) *subapterus*, n. sp., is then described and separated from *destructor*, the wingless specimens referred to by Say and Herrick under this last species being considered as belonging to *subapterus*. *Subapterus* is exceptionally winged. *Destructor* is, on an average, of smaller size, more uniformly metallic in color; has a flatter abdomen with yellowish spot at base; has the antennæ similar in both sexes and either pale brown or blackish brown; has the coxæ metallic black, the femora brown or black except towards tip, the paler parts of the legs whiter than in *subapterus*, and does not, so far as we now know, occur in the apterous condition.

Subapterus is, on the average, larger; of darker color and less metallic, with the flagellum of the antennæ pale in the male and black in the female; the abdomen much more rounded and without the pale spot; the coxæ, trochanters, femora and basal part of tibiæ honey-yellow. It occurs mostly in the wingless condition.

The paper next treats of *Eupelmus allynii* French, showing that it is parasitic on both *Isosoma hordei* and *I. tritici*, as well as on the Hessian fly. The polyphagic habit of this genus is then shown, and the experience of the author is given in breeding species from Lepidopterous eggs, from Orthopterous eggs, from Hemipterous eggs, from Cynipid galls, from Lepidopterous larvæ, from Coleopterous larvæ and from free Cecidomyid larvæ.

Tetrastichus productus, n. sp., is described and the inference drawn from the habits of the genus that it may be a secondary parasite.

Platygaster herrickii Packard is then treated of with the conclusion that *P. error* Fitch is parasitic on some other insect and not on the Hessian fly. The statements of both Herrick and Professor A. J. Cook are then considered in reference to the oviposition of this species in the eggs of the Hessian fly. The author, while disinclined to oppose direct observations when asserted, even

[1] Abstract of a paper read before the Am. Ass. Adv. Sci. at Ann Arbor, by C. V. Riley.

when such conflict with all that has before been known or with previously uniform unity of habit, still feels that the observations need verification, and that it is probable that both Herrick and Cook mistook the young Hessian fly larvæ for the eggs.

Another species of Tetrastichus to which Professor S. A. Forbes has given the MS. name of *carinatus*, is briefly referred to as being in all probability a secondary parasite, and a single Microgaster is mentioned but not described, as some doubt exists as to whether it is parasitic on the Hessian fly, although it was bred from straw infested by this last.

FORBES' REPORT ON THE NOXIOUS INSECTS OF ILLINOIS FOR 1884.—Professor Forbes' third report abounds in new matter of interest both to the entomologist and the agriculturist. Besides the new Crambus feeding on the roots of the corn, two leaf-rolling moths are described, as well as the corn aphis, with notes on other corn insects. Among the wheat insects there are fresh contributions to our knowledge of the Hessian fly and its parasites, the facts ascertained strongly suggesting the hypothesis of a normal completion, before harvest, of the transformation of a considerable part of the destructive spring brood of the larvæ. Three new parasites are described, viz: *Pteromalus pallipes*, *Pt. fulvipes*, and *Tetrastichus carinatus*. The wheat midge is re-described in all its stages and new observations on its habits are presented. Several pages are devoted to the grass worm (*Laphygma frugiperda*), some clover insects are described, as well as insects injurious to the smaller fruits, as the apple and pear, and some shade trees. Though the report is a somewhat miscellaneous one it contains considerable novel matter. Many of the illustrations are unequal and some are not so good as they should be, probably from lack of means afforded by the State authorities, and the lack of first-class artists. The appendix is exceedingly useful, as it contains general indices to the first twelve reports of the State entomologists of Illinois, the plant index being particularly useful.

FLIGHTS OF LOCUSTS IN EASTERN MEXICO IN 1885.—Much destruction resulting from the presence of great swarms of locusts were reported in the newspapers in Eastern Mexico in September of the present year. While at Cordova, in March last, I was told by Mr. L. H. McCormick, of Chicago, who was then on his way to Vera Cruz from the City of Mexico, that he witnessed a flight of locusts between Esperanza and Orizaba on March 24th. They made the sky dark, and were of the size of our large grasshoppers. I may add that during a month's sojourn in Mexico I did not see any locusts, not even along the stage road from Saltillo to San Miguel. The swarms must be quite local, and originate in the *tierra caliente*, or tropical zone of Central America, south of Mexico.

From Dr. A. A. Russell, of Cordova, to whom I was indebted

for much kindness during a short stay at Cordova, I obtained the following information regarding the destructive locust of that region. Within the last two or three years locusts have devastated portions of Central America, and for two years past they have extended over nearly the whole of the States of Vera Cruz, Oaxaca, Chiapas, Morelia, Michoacan and the intervening country to Matamoras. Dr. Russell lost perhaps $3000 worth of coffee trees on his plantation, and in a single year spent nearly $1000 in fighting locusts.

According to his statements the swarms of locusts arrive from Central America over a period lasting from April to November, viz., from seed time to harvest. They deposit their eggs in April and May, the young hatching in from twenty to thirty days, and becoming fledged in three months. The young locusts do the most harm, and travel in dense masses, sometimes six inches deep, leaving the ground behind them black, as if burned by fire. They are often so thick in the roads that the horses will slip and slide over their crushed bodies. They are particularly destructive to the young coffee plants, gnawing off the bark from the young trees and from the tender branches of large trees, but they do not eat the leaves. Oranges, palms, corn, rice and tobacco plants also greatly suffer from the attacks of this locust. Unfortunately no specimens could be obtained so as to learn which species does this wide-spread damage. It is probable that the insect is *Acrydium americanum*, as we have received specimens from Yucatan. For other accounts of the ravages of locusts in Central America and Mexico, see first report of the U. S. Entomological Commission, pp. 460–465; also third report, appendix, p. 60.—*A. S. Packard.*

Chinese Insect White Wax.—At the last meeting of the British Association, Mr. A. Hosie read a paper on "Chinese insect white wax," in which he stated that, although the province of Szu-chuan, in Western China, where he had been stationed for the last three years, was the chief wax insect and wax-producing country in the empire, insects and wax were found in other provinces. Mr. Hosie was called upon by the Foreign Office to collect for Sir Joseph Hooker specimens connected with, and all possible information on the subject of this industry, and the present paper was a revision, with additions, of a report already published in a Parliamentary paper in February last. He described the insect-producing country, the tree on which the insects were propagated, the insects themselves, and their transit from the valley of Chien-chang, their breeding ground, in the west of Szu-chuan, across the mountains to Chiating Fu, the habitat of the wax tree. The tree was then described, and details were given of the treatment of the insects, their suspension on the trees, the depositing of the wax, and of a parasite on the insects. The method of re-

moving the wax from the branches of the tree and of preparing it for market was then explained. Thereafter Mr. Hosie detailed the result of an examination of the insects after the wax had been fully deposited, and finally passed to the annual quantity of insect white wax produced, its value and uses.—*English Mechanic.*

Palpi of Insects.—Examination of above fifty individuals of diverse forms of Orthoptera and Coleoptera have caused M. F. Plateau to reach the following conclusions respecting the use of the palpi: (1) During the act of eating they remain inactive. (2) Deprivation of the maxillary palpi does not hinder the insects from eating as usual. (3) Loss of the labial palpi has no more effect. (4) Smell remains the same after the four palpi are taken away. (5) The amputation of all the palpi does not prevent these insects from recognizing and seizing their food. (6) Loss of all the palps does not prevent them from feeding as usual.

Entomological News.—We have received from Dr. G. Mayr a detailed work on fig insects, consisting of 105 closely-printed pages, with three excellent plates.——Dr. J. A. Lintner, the State entomologist of New York, has issued a lecture on cut-worms, read before the State Agricultural Society in January last.——One of the most valuable contributions to entomology of the year is Mr. Poulton's "Farther notes on the markings and attitudes of lepidopterous larvæ, together with a complete account of the life-history of *Sphinx ligustri* and *Selenia illunaria*," in the second part of the Transactions of the Entomological Society of London, for 1885. Among the topics discussed in this paper are the following: The utilization of the changes in color before pupation for protective purposes, and an anatomical reason for the special protection of larvæ, wherein the author shows that the various means of protection in larvæ are always of a passive kind. When active (flagella) they seem to be directed against the attacks of ichneumons, which produce fatal results in quite another way. "Nearly all the means of defence against other enemies are such as tend to prevent the larva from being seen or touched, rarely such as to be of any avail when actually attacked." This Society has within a few months obtained a royal charter.——The death of Mr. H. K. Morrison, so well known as a zealous and successful collector, in May last, was sudden. There is a good opening for one or more efficient collectors in this country to succeed Belfrage, Boll and Morrison.

ZOÖLOGY.

Recent work on Balanoglossus.—W. Bateson[1] has recently investigated the morphology of Balanoglossus, and thrown a great deal of light upon this hitherto obscure and little understood animal. A summary of his results is as follows: There is

[1] Quarterly Journal Mic. Soc. Suppl., 1885.

a spherical gastrula, large circular blastopore, later the body is elongated, the blastopore closes completely, a ring of strong cilia forms about the blastoporic area, the blastopore being placed eccentrically in the ring. The body becomes constricted by a transverse ring, a second forms behind it, and the body is thus cut off into three regions corresponding with the future proboscis, collar and body portion; the end of the proboscis is furnished with a tuft of cilia. A groove forms in the middle line of the dorsal region of the collar, and at the same time the dorsal nerve cord is delaminated from this ectoderm. At the same time a pore perforates the skin behind the collar on either side, placing the endoderm and the ectoderm in communication, and furnished with cilia, it is the first pair of gill slits. The mouth forms in front of the collar at the base of the proboscis, and later the anus arises at the opposite end of the body. In the species whose life-history is dealt with in this paper, viz., *Balanoglossus kowalevskii*, the development in the external form proceeds by the direct growth from the form now arrived at to the adult by the elongation of the body, the addition of the gill slits and the differentiation of the body region into the branchial and digestive portions, and the disappearance of the ring of cilia and the tuft of cilia upon the proboscis. There is thus no Tornaria stage included in the life-history of *B. kowalevskii*, but the development is direct. Bateson does not discuss the question of the relations between the echinoderms and Balanoglossus, reserving it for the fuller discussion that is promised in a future paper.

The history of the internal changes is briefly as follows: The endoderm was invaginated, as seen from the surface; from it arises the mesoblast in three separate masses, one anterior unpaired mass in the proboscis, two anterior lateral masses, two posterior lateral masses. These all arise as diverticula of the archenteron, and their cavity, at first continuous with that of the primitive gut, becomes the various portions of the body cavity. A forward proliferation on the dorsal side of the gut wall, with at first an opening into the gut cavity, gives rise to a solid supporting organ which runs from the collar region into the proboscis, and is the homologue of the notochord of the Chordata. The walls of the anterior unpaired body cavity is produced backward as two horns, the left comes to open to the exterior by a pore in the proboscis, the right lines the body cavity of the proboscis. The anterior pair of diverticula becomes filled almost completely, and the posterior pair form the most of the cavity of the body. In the collar region the edge of the collar posteriorly overhangs the body wall to such an extent as to partially close in a cavity there, open behind, in which the first pair of gills lie, this space is called the atrial cavity. A duct arises in a thickening in the wall of this space, and places the cavity in communication with the body cavity of the collar. Nothing is yet determined in regard to the generative system.

Balanoglossus presents resemblances, though with some difference, to Amphioxus in the following points: Origin and persistence of the notochord and its relation to the alimentary canal, position of the blood-vessels of the gills and the form of the gill bars, position and mode of origin of the central nervous system, origin of the mesoblast and body cavity, the atrial fold and the duct from body cavity into the atrium—similar to the excretory tube of Amphioxus.

The complete discussion of the affinities of Balanoglossus is reserved for a future paper, but Bateson proposes to associate it as follows:

Hemichorda	=	**Enteropneusta**
Urochorda	=	**Ascidians**
Cephalochorda	=	**Amphioxus**
Vertebrata.		

—*Henry Leslie Osborn.*

The Reproduction of the Common Mussel.—Professor W. C. M'Intosh describes the reproduction of the mussel (*Mytilus edulis*). The sexes are distinct in the adult form, but in the undeveloped condition the structure of the organs seems to be similar in both sexes. The shape of the valves gives no reliable distinction. The reproductive elements are developed in the mantle; the male presents in January, in the thickened generative region of the mantle, large pale round sperm-sacs filled with minute spermatozoa, which have minute ovoid bodies with finely filamentous tails. They are lively and tenacious of life. Twenty-four hours of exposure, however, seems to be fatal to them. The females have the same region of their mantle crowded with a prodigious number of minute ova. Throughout February the development increases, and the whole surface of the mantle becomes speckled in both sexes with the reproductive elements. After full maturity is attained, as in April, the orange mantle is richly marked in an arborescent manner by racemose sperm-sacs and ducts, especially towards the margin. In the females this is not so evident, the ova being grouped in masses and densely packed.

From this time the activity of the spermatozoa and the number of the ova diminish, till in July neither ova nor spermatozoa can be distinguished microscopically.—*Journal of the Royal Microscopical Society, June, 1885.*

Manner in which the Lamellibranchs attach themselves to Foreign Objects.—Dr. J. T. Cattie describes the means by which the common mussel attaches itself to foreign objects. When the foot commences to grope about, it may become two or three times as long as the body of the animal without finding any object within its vicinity; it then moves about till it finds some point of support, when this is effected there appears from the transverse cleft which terminates the ventral groove a whitish sub-

stance which gradually becomes more opaque; sometimes the slit takes on the form of an equilateral triangle, and then the quantity of matter which exudes from it is greater; this matter obviously comes from the cylindrical tubes which are scattered in the glandular substance of the foot. A terminal plate having been formed the foot is withdrawn, and the plate and the byssus are merely connected by a delicate thread. The time necessary for an animal of average size to form the plate varies between 55 and 90 seconds; in some cases two connecting threads become developed. The terminal plate, when studied under the microscope, was found to be formed of thousands of small granules, irregularly distributed, and varying considerably in size. The fine threads appear to be formed by the agglutination of granules of various sizes, but large granules are formed by the fusion of several smaller ones.

The formation of the byssus is regarded by the author as being very simple; the walls and the lamellæ of the byssus-cavity continually secrete a byssogenous matter; the lamellæ in the anterior and narrow part of the cavity unite and fuse with one another, while the narrow shape of the orifice gives the byssus-threads their form. Owing to the relations of the ventral groove of the foot each byssus-thread is immediately fused to the main trunk.

The author doubts the correctness of A. Müller's view that there is an agglutinating and a byssogenous substance; and speaks severely of the artificial character of that author's classification of the species.—*Journal of the Royal Microscopical Society, August, 1885.*

Pulmonate Uropneustic Apparatus.—H. von Ihring[1] writes upon the morphology of the lung cavity in the Helicoidea. While in Cyclostoma, also in the Limnæida, the lung is plainly a modified gill cavity and still contains in the adult, in some form, the rudiment of the gill, in the Helicoidea the lung is not at all the remains of an old mantle cavity, but is a special cavity formed by a dilatation of the duct leading from the excretory organ to the exterior, and the breathing pore occupies precisely the place occupied by this orifice in the opisthobranchs. Semper had differed from von Ihring upon this, and claimed that the lung was a modified gill cavity, so von Ihring made observations upon a number of forms, among them Onchidium and Vaginulus. These he concludes to be the lowest forms in the Helicoid phylum, forms from which the helicoids have been derived, and further forms which, derived from marine ancestors, have been adapted to an amphibious habit and given rise to descendants wholly air-breathing. There is in Onchidium not the slightest trace of a gill in the lung cavity, and this is situated at the end of the meter. This paper opposes the view of Borgh that Onchidium is a pul-

[1] Zeitsshr. f. w. Zool. 41, p.259, 1885.

monate adapted from a terrestrial to an amphibian mode of life. —*Henry Leslie Osborn.*

HELIX CANTIANA AT QUEBEC.—Few accessions from abroad to our lists of land shells having lately been recorded, the discovery in Canada of a large colony of a foreign species, not previously known to occur on this continent, is of more than ordinary interest. When at the ancient capital recently, in ascending the steps from Dufferin terrace to the citadel, I stopped to recover breath on a stage considerately provided for such purposes, at a point at about thirty feet from the summit of the glacis. From this resting place a path, trodden only by goats and equally sure-footed Quebec gamins, leads upward in a westerly direction along the steep and narrow slope between the south walls of the citadel and the almost perpendicular rock on which it stands. Noticing a small helix moving on the path, I passed under the guard-rail and ventured out upon it, not indeed wholly without fear, as there was danger, in case I slipped, of falling into Champlain street, four hundred feet below. The shell, which proved to be *Helix rufescens* Pennant, was found in abundance, in company with numerous *Limax agrestis* L., clustering around the roots and climbing the stems of a tall, rank weed, apparently a species of Ambrosia. An occasional specimen of a larger shell, which I supposed to be immature *H. hortensis*, was also found at intervals along the path; and directly above where Montgomery fell, it occurred in considerable numbers in scattered clumps of grass which had obtained a foothold on the shaly cliff. It seemed strange to me that among the many shells no mature *H. hortensis* could be observed; but thinking it could be no other species, I was content with collecting about a dozen specimens, though I might readily have obtained hundreds; and picking my steps carefully back to the point of departure, gave the shells no further thought until after my return to Ottawa. When preparing the *H. rufescens* for the cabinet, I examined with more care than previously the associated shell, and surmising that, instead of immature *H. hortensis*, it was *H. cantiana* Montague, proceeded to compare it with specimens of the latter species received some years ago from Mr. Hey, of York, England, and with the description and figure given in Jeffreys. The comparison at once removed all doubt of the identity of the Quebec shell. It lacks in general the rufous concentric line conspicuous on the body whorl of the English specimens of *H. cantiana*, and is somewhat smaller; but has the reddish band around the aperture, and is in every other respect the same. I have described the locality in which it is found with some minuteness, in order that visitors to Quebec may obtain specimens, if they think it worth the trouble. I might add that it was a warm, moist evening when I found the shells.—*Frank R. Latchford, Ottawa, Ont.*

RATS NESTING IN TREES.—In the neighborhood of New Almaden, Santa Clara county, Cal., I observed, during August of this year (1885), that in many of the small oaks there were masses of twigs, some of the masses as large as a bushel measure. On examination I found that each of the twigs showed evidence of having been gnawed off by some rodent. These nests proved to be inhabited by a species of rat about the size of the domestic rat, but finer looking, and with larger ears. They probably belong to the genus Neotoma of Say and Ord. The rat that builds a conical nest on the ground, of twigs and branches to the heighth of two or three feet, is probably of the same species as this living in the trees, as I found the nests of the two near together, and sometimes a nest would be half on the ground and half in the tree. —*H. W. Turner, U. S. Geol. Survey.*

PRELIMINARY NOTE ON THE ORIGIN OF LIMBS.—From my studies on the limbs of vertebrates I get the following results:

1. There exists no "homodynamie" between the skeleton of the gills and the limbs (Thatcher, Mivart, Balfour, v. Rautenfeld, Dohrn).

2. The original form of the paired fin is like that of the unpaired, and consists of parallel rays vertical to the axis of the body on a horizontal plane (Thatcher, Mivart, etc.).

3. These rays unite proximally to form the *basipterygium*, which turns out, forming the posterior border of the fin, the *metapterygium* (Balfour).

4. The extremities of the higher vertebrates have originated directly from the fin by a rotation of the latter through 180° in the direction of the hands of the clock.

5. The extremities of the higher vertebrates have originated by reduction of the propterygium and mesopterygium and the following rays of the metapterygium.

6. A line drawn through humerus, radius, radiale, carpale$_1$, metacarpale$_1$, digit$_1$ in the urodelous batrachians corresponds to a line along the basipterygium, or the first ray of the metapterygium.

7. The oldest known extremities of the higher vertebrates are seen in the Menopomidæ, in Salamandrella and Ranodon, among the batrachians (two central bones), in Plesiosaurus, Pliosaurus, Baptanodon (Sauranodon, rudiments of ulnar rays ["olecranon"]). A fact of great interest is the presence of *two central bones* in *the carpus of the Rhynchocephalia* (Hatteria, Proterosaurus) never observed before.

8. The reduction of radial rays in the higher vertebrates is a secondary condition produced by the adaptation to a terrestrial life.—*Dr. G. Baur, Yale College Mus., New Haven, Conn., Oct. 2, 1885.*

ZOOLOGICAL NEWS.—*Protozoans.*—Dr. R. Blanchard (Bull. de la Soc. Zool. de France), in an article modestly entitled, "Note sur le Sarcosporidies," gives the history of our knowledge of these parasites from their first discovery by Miescher in the muscles of a mouse to the present time, and presents an essay upon their clasification. These Sporozoa or Sarcosporidia are intimately related to Coccidium and especially to Klossia. They have been found in the mouse, the pig, the horse, the ox, the sheep, the dog, the cat and the rabbit, and more rarely in those of man. Virchow has noticed that they produce no change in the muscular tissue. As they occur in the ape, it is clear that man is not safe from them, and Lindemann has described them from the valves of the human heart. As they enter the system by the digestive canal, the practice of cookery explains their comparative rarity in man.——At the Académie de Sciences of Paris, M. A. M. Edwards presented a note of M. de Folin, relating a curious form of reticulated rhizopod which inhabits what seems to be small pebbles in hardness and aspect. The organism forms a sort of paste of foreign particles and sarcode and covers the whole with a secretion like that which forms the test of a porcellanous foraminifer, and is not only smooth, polished and shining, but colored in many tints. These foraminifers form the genus Lithozoa, with numerous species.——M. R. Blanchard has described a peritrichous infusorian ectoparasite of fresh-water fish. *Apiosoma piscicola* is fixed during its whole existence.

Worms.—The thesis of M. J. Porrier for degree of doctor of the faculty of sciences at Paris, has for its subject the trematodes. The structure of the skin, and the anatomy of the suckers are thoroughly treated, and details noted which need figures to be understood. The most interesting fact in relation to the digestive tube is the description of the absorbent hairs. The ciliated sac which surrounds the prostate gland and seminal receptacle seems to serve only to protect the prostate and plays no part in copulation. The canal of Laurer also, once considered a copulatory organ, is but a reservoir, so that the only probable and admissible mode of fecundation is external self-fecundation, such as Sommer admits for the cestodes. M. Porrier has also collected facts of importance relative to the structure of the nervous system. ——M. Remy Saint-Loup describes a new marine oligochete, many characters of which are analogous to those of Pachydrilus Claparede, but which is transitional between that genus and Enchytracidæa.——An examination of some tunicates collected by various arctic expeditions have been made by C. W. S. Aurivillius, in order to discover crustacean parasites. Two amphipods, *Andania pectinata* and *Aristias tumidus*, were found, together with nine copepods, six of which were new. Out of four of these our author makes two new families. As a rule a parasite seems to affect a single genus or even species.

Reptiles.—M. Le Vaillant has described a new species of land tortoise, *Testudo yniphora*, captured in or near the Comoro isles by some Arab sailors. Its carapace is highly convex, or hemispherical, the anterior and posterior apertures but slightly elevated, recalling those of *T. radiata*. The plastron has a peculiarity which enables it to be distinguished at sight from all other tortoises, and is the motive of the name given to it. In color the back is reddish-yellow with brown on the periphery of the plates, while the plastron is pale yellow.

Mammals.—An example of *Kogia breviceps*, the pigmy sperm whale, was taken in 1884 at Spring Lake, N. J. This was the first time that this rare species had been taken in the Atlantic. The specimen, like the majority of those hitherto taken, was a female. The Smithsonian Institution has just received a specimen of a male of this species, taken at Kittyhawk, N. C. Mr. True states that it is about nine feet long and apparently adult. Near the anterior end of the upper jaw are four slender curved teeth, similar to those of the lower jaw, but smaller. Two teeth are said to occur in a similar position in a specimen from India, described by Sir R. Owen as *Euphysetes simus*. The genital opening is situated anterior to the line of the front margin of the dorsal fin. The stomach contained only the beaks and eyes of cuttlefish and a great quantity of nematoid worms. A large quantity of cestoids, apparently Phyllobothrium, were found encysted in the integuments of the back, especially about the dorsal fin.——The distribution in height of the mammals around Kilimanjaro is interesting. *Cercopithecus pygerythrus* was found at an elevation of 5000 feet, and the guereza, which is very common round the base of the mountain, at 3000 feet; the lion does not ascend beyond 3000 feet, but the leopard is very common up to 7500 feet. *Genetta tigrina* occurs up to 7000 feet, and *Herpestes caffer*, though not a mountain animal, ascends as far as the village of Moshi (5000 feet), as does also *Canis lateralis*. *Hyrax brucei* reaches 10,000 feet; the elephant 13,000, while the buffalo, the koodoo and a Neotragus attain to 14,000 feet above the sea. *Equus burchelli* and *Rhinoceros bicornis* do not ascend beyond 2300 or 2400 feet.——The Proceedings of the Zoölogical Society of London (Part II, 1885) contain a valuable article upon the anatomy, classification and distribution of the Arctoidea, by St. George Mivart. The genera are taken up separately, and the habits, distribution, external appearance, dentition, skeletal characters and proportions of each are carefully described. The classifications of Turner and Flower are given, and the article concludes with the author's arrangement, which differs from that of Flower as follows: Ailuropus is removed from the Ursidæ and placed with Ailurus in the section Ailurinæ of the Procyonidæ. The entire Arctoidea thus fall into the three families Procyonidæ, Mustelidæ and Ursidæ.——Dr. J. Struthers

(Jour. Anat. and Phys., January, 1881) gives the result of an examination of the bones, articulations and muscles of the rudimentary hind-limb of the Greenland right whale. Ten sets of these parts were dissected. The synovial capsule of the knee-joint, the acetabular cartilage, a synovial cavity and head of the femur are present, and an apparatus of strong ligaments is attached to the femur, permitting and restraining movements in certain directions. But these movements of the femur are limited, and in two examples the hip-joint was anchylosed without trace of disease. The muscles of these bones may be arranged in four groups, three of which connect them with other parts: (1) Internally with the genital organs; (2) a posterior or caudal mass; (3) an anterior or trunk mass; while the fourth connects the bones to each other.——According to Mr. P. L. Sclater, the wild ass of Somaliland is a new species, or at least subspecies, and is distinguished from that of the Nubian desert by its generally paler and more grayish color, the entire absence of the cross stripe over the shoulders, the very slight indication of the dorsal line, and the numerous black markings on both front and hind legs. It has also smaller ears and a larger and more flowing mane.——Mr. W. Leche (Proc. Zoöl. Soc., 1884) describes some Chiroptera from Australia, including the new species *Nyctinomus petersi* and *N. albidus*. In the latter species the ears are much larger than the head, and are united by a low band.——Mr. J. W. Clark describes (in the Proc. Zoöl. Soc.) a series of stuffed sea-lions belonging to the Australian Museum, Sydney, and from a study of these and other examples concludes that *Otaria cinerea* is "one of the four distinct species of Otaria inhabiting the Australian coast."——M. Fernand Lataste contributes to the Proc. Zoöl. Soc. for 1884, a description of a new species of Meriones, *M. longifrons*, from Arabia, together with a full account of its habits, intelligence and sexual relations. Gestation normally lasts twenty days, and the ovarian period about ten days.

EMBRYOLOGY.[1]

The Archistome-Theory.—The new doctrine of development, of which it is proposed to give a brief and partial sketch here, rests in part on a hypothetical basis and in part upon a well established theory founded upon observation. It consists further in an expansion and adaptation of the gastreal-theory of Haeckel in the light of more recent research, and a reconciliation of it with the deductions of His, Rauber, Whitman and myself, as to the occurrence of concresence of the lips of the blastophore and the differentiation of the axis of the body of the embryo from behind forwards, generally of bilateral types with paired mesoblastic sacks derived

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

directly or indirectly from the archenteron. It is also assumed with Sedgwick[1] that the most primitive form in which an imperfect approach towards the differentiation of a body-cavity is evident, as paired pouches of the archenteron, still opening into the latter, is seen in the bilaterally differentiated Actinozoa. It is further assumed that this modification of the archigastrula, as the primitive gastrula may be called as defined by Haeckel, is the first intimation which we have in any existing type, permanently represented in the ascending scale of morphological differentiation of organisms, of the permanent assumption of bilaterality. It is also assumed with Sedgwick that the mouth of such a form was elongated in an antero-posterior direction, thus leading to the differentiation of a permanent mouth and anus at the opposite ends of the original slit-like mouth of such a form. The circumoral band of sensitive tissue is also assumed to have given rise to the median nervous system of Chordata and Achordata. In the former median concrescence of the originally paired cords has been complete, and in the latter incomplete, so as to give rise to circumoral and circumanal nerve rings and a pair of ventral ganglionated cords. It is thus made obvious that I assume in a general way that the hypotheses propounded by Sedgwick are supported by a very large body of evidence and enable us to interpret and reconcile with great readiness the conclusions of biologists in reference to the development of other structures, especially the excretory, generative and appendicular organs. The evolution of the first two, the trachea of insects, the branchiæ of various forms, abdominal pores, muscular somites, etc., has been more or less fully discussed by Sedgwick himself, but the probable source and genesis of the limbs and appendicular organs he has hardly more than alluded to. To this part of the subject and the nature of the gastrula of bilateral forms I shall therefore especially address myself, and I hope greatly expand and further emphasize the views of Balfour's very worthy successor.

The antero-posteriorly elongated primitive gastrula mouth or blastophore of bilateral forms is assumed to have become secondarily elongated, either by a direct and obvious process of median concresence of its lips, as in Clepsine, in fishes, in Peripatus and arthropods generally, or this has become greatly obscured, as in Balanoglossus, Branchiostoma, Chætopoda, Chætognatha and some of the higher chordata and in certain degenerate types, as a result of secondary modifications which have immediately affected the primary sequence of events in the development of the neural plate or medullary groove. I therefore assume, in effect, that the medullary plate in all forms has been primarily formed from the concresced lips of an elongated blastopore, and this has in the

[1] On the origin of Metameric Segmentation and other morphological questions. Studies from the Morph. Laboratory in the University of Cambridge, II, 1884, pt. I, pp. 77-116, pls. x and xi. Also in Quart. Jour. Mic. Science, 1884.

lower forms been very generally perforated in the median line anteriorly to form the permanent mouth, and posteriorly to form the anus. The secondary modifications which have affected this mode of development of the permanent openings into the enteron depend, apparently, in large part upon a change in the aspects of the body, especially in the chordata in which the permanent mouth and anus are both new developments and do not coincide with the mouth and anus of primitive Bilateralia.

The primitively elongated mouth of the larvæ of Bilateralia, with an extended body-axis, or any derived form of the latter, or wherever there is formed a well-defined, unpaired median neural plate, or where a pair of parallel neural plates or cords are developed, I would call the whole area thus embraced an *archistome*. In the higher forms this archistome would be coëxtensive with the neural groove antero-posteriorly, as far forward as the pineal body, and as far backward as the true secondary blastopore, and even beyond it, when a primitive streak was formed by the concresence of the limbs of the blastoderm behind the posterior end of the axis of the embryo. In other words the archistome would extend from the pineal body in chordate embryos along the whole length of the embryonic axis through its blastopore and on through the primitive streak to the point where the yolk-blastopore closed. If the archistome were, therefore, to remain open, it would present the appearance of a cleft dividing the embryo into two symmetrical halves through the median line, and would extend even through the aborted portion of the lips of the primitive blastopore when a very long primitive streak was developed. It is thus rendered evident that I do not regard the unmodified, round gastrula-mouth, as understood by Haeckel, as always representing all of the blastopore in higher forms. According to this view the original gastrula-mouth is in fact greatly elongated as a result of growth in length, in consequence of which bilaterality becomes established, and of which we have the first hint in the Actinozoa. This is further intensified by development from before backwards, since, without exception, the elongate Bilateralia differentiate the cephalic end of the body in advance of the caudal. In confirmation of the foregoing views I would refer the reader to the existing special memoirs on the development of the primitive grooves and blastoderms in the fishes and arthropods (Tracheates especially).

Furthermore, the phylogeny of the mesoblastic somites is absolutely untraceable to any other source except to the gut pouches of a bilateral type approximating the Actinozoa, and whether the process has been abbreviated in arthropods or not, we are at least certain that in some primitive Chordata, the Teleostei, for example, the proof that the mesoblastic somites of the body grow from the concresced lips of the blastopore are so conclusive as to be incontestible. The way in which the mesenteron arises, and

the manner in which the primitive cumulus is formed at the germinal pole of blastodermic vesicle of Arthropoda indicates, it seems to me, taking into account the fact that the mesoblast is split off from the lower side of the neural plate, that the mesoblastic somites are here formed in essentially the same way as in the Chordata. The invagination or folding in of the germinal area, in insect embryos to form the amnion, at first posteriorly and at the sides, or according to the plan just the reverse of what holds in the formation of the amnion in the endocyemate types of Chordata, is to me conclusive proof that concrescence of the lips of the primitive elongated blastopore, or archistome, has taken place; for, in order to effect this sort of an invagination of the embryonic area the head end must for a time remain fixed, while the tail, continuing to grow in length, is thrust into the yolk, as in Calopteryx, carrying the amniotic limb of the blastoderm before it. It also seems that paired cavities soon appear in the mesoblastic somites underlying and derived from the epiblast, as above described in arthropods. I therefore see no very essential difference in the method of development in the two types. In both it is obvious that a portion of the archenteric walls of the elongated archistome has given rise to the mesoblastic somites, by a process which differs in no respect from, but agreeing even in its abbreviation with that which takes place in Branchiostoma directly from the sides of the archenteron.

We now come to the consideration of the most important part of the archistome-theory, namely, that portion of it which deals with the genesis of the limbs and their musculature. The readiness with which the view that the tentacles of an actinozoan ancestral form gave rise to the integument and musculature of the paired limbs of the Bilateralia is reconcilable with all the facts of embryology, is very remarkable. As is well known, the tentacles of Actiniæ consist of an outer layer of epiblast into which a hypoblastic lining is thrust from the paired lateral gut-pouches. If the gut-pouches of the actinian were now shut off from the archenteron we would have mesoblastic somites developed and structures formed which are exactly recapitulated in the development of the Arthropoda. That is, the outer layer in the budding appendages of the embryos of the latter, which grow out from each segment, are constituted of the same two layers, the outer of which gives rise to the hard, chitinous joints, and the inner to the muscles which move them.

In the development of bilaterality through the actinozoa the circle of tentacles would be drawn out into an ellipse, or so as to enclose an oblong space surrounding the archistome. This would bring the primitive appendages, after a free existence had been assumed by the supposed ancestral actinozoan type, into about the position in which they grow out in arthropod embryos around the archistome or furrow in the neural plate. The

post-anal telson or bristles, and the preoral labrum and one or two pairs of antennæ may be supposed to have been derived from a postanal, and a preoral series of tentacles respectively, supposing of course that the mouth is formed from the anterior part of the archistome, while the anus is formed from its posterior portion, while, as supposed by Sedgwick, the middle portion has coalesced.

The biramose legs of Crustacea and certain insects may be supposed to have arisen from a bilateral actinozoan type in which there were two rows of tentacles encircling the oblong archistome. When the inner and outer archipodia of one side, as we may name these primitive limbs, had fused at their bases, we would have a biramose appendage. As the outer layer became chitinized these appendages would become segmented. A very primitive type of limb, which may be supposed to have been derived from the tentacle of an actinozoan ancestry, is found in Peripatus. The parapodia of worms may also be supposed to have been derived from two such circles of archipodia which surrounded the archistome, but which, as the body became elongated, assumed a more and more lateral position. A new set of structures are, however, developed in the parapodia of errant marine worms, the analogues of which are found only in the fin-folds of the embryos of osseous fishes, or as the rays of the most primitive and undegenerate types of adult forms, namely, the Elasmobranchii, Holocephali and Dipnoi. These structures are the setæ which are of epidermal origin in the worms, or at most subepiblastic; as in embryo fishes and in Sagitta. In a former number of this journal I have called these structures in fishes actinotrichia; these are the same as the embryonic fin-rays mentioned by A. Agassiz.

The principal reason why I consider the actinotrichia found in fish embryos analogous if not homologous with the setæ found in the appendages of worms, is the fact that in both cases muscular processes of the mesoblastic somites first become attached to the inner ends of these fine horny or chitinous filaments, which in the worms protrude beyond the margins of the soft tissue of the parapodia, but which in embryo fishes and in Sagitta do not extend beyond the edges of the fin-folds. It is thus rendered obvious that bundles of muscular fibers derived from the muscular somites, developed from lateral gut-pouches, pass outward and are inserted upon the proximal ends of the setæ found in the parapodia of worms as well as the actinotrichia found in the fin-folds of fish embryos. In fishes these muscular processes are given off to the actinotrichia of the unpaired as well as to those of the paired fins. These muscular processes moreover pass outward into epiblastic folds in both cases metamerically or from each segment. In the worm to a bunch of setæ in a single parapodium, in the fish to a bunch or longitudinal series of actino-

trichia to the number of a dozen or so opposite each segment. In fish embryos the actinotrichia finally have their proximal ends drawn together out of their original parallel position under the epiblast of the fin-fold, and radiate more or less markedly from the point where the muscular process from the mesoblastic somite is inserted upon them, the same as the diverging setæ in the parapodia of worms. This divergency gives rise to the dichotomous character of the bony rays of Teleost fishes, since, as I have shown in a previous article, the actinotrichia are the rudiments of the permanent osseous, segmented rays of the malacopterygian type. For these reasons I am very strongly inclined to believe that the parapodia of worms and the fin-folds of fishes are very intimately and probably genetically allied to each other.

Another strong reason for such a belief is that in Sagitta in which the transverse septa in the body-cavity have been obliterated, as in Chordata, the setæ are found, as in fish embryos, lying parallel with each other and in horizontal, lateral, continuous fin-folds. This would seem to indicate that Sagitta had descended from a worm in which a lateral row of parapodia had gradually become fused together serially by their edges so as to form a more or less nearly continuous lateral fold. And I see no reason to doubt that a similar longitudinal or serial concrescence of primitively distinct metameric finlets may have occurred in the Protochordata, and given rise to the median and lateral longitudinal fold from which all of the fins develop. The next strong reason for this conclusion is that an actual longitudinal concrescence of the metameric elements of the paired and unpaired fins of fishes actually occurs. This is especially obvious to any one who has studied the mode of development of the fins of fishes in which extensive longitudinal concrescence has taken place, and of which any one who will examine an adult skate may easily satisfy himself. In this form the pelvic and pectoral pairs of fins have been formed of a primitively continuous series of metameric elements, as shown by the development. The anterior part of the lateral series of metameric elements of the fin-fold in this type are crowded together at their bases to form a pectoral, the posterior part of the series of elements are in the same manner crowded together to form the pelvic fin. In this way it comes about that the rays and metameric elements lose their original parallel position with respect to each other and become divergent distally, while the basal parts of the skeletal series of elements concresce or fuse to form the compound pro-meso and metapterygial pieces.

The lateral fins of fishes I regard as having arisen from the serially fused notopodial appendages of a worm-like ancestor, the unpaired fins in like manner I regard as having arisen from parapodia; the dorsal median fold from the two lateral rows of neuropodia which have concresced on the median line, and the ventral fold from the two rows of notopodia which have in like

manner fused together on the median line serially and transversely. The actinotrichia of all the fins are accordingly represented ancestrally in the slender embedded part of the parapodial setæ of worms.

These conclusions seem to support those of Dohrn, but also receive additional support from a consideration of the segmental organ and the way these are developed in certain worms, according to Hatschek, and in Chordata, according to Semper and Balfour. In one other important point the primitive Chordata and chætopods agree, namely, in the possession of a great number of segments or mesoblastic somites. I therefore regard the Chordata and Chætopoda as representing two divergent series. The former, upon the concentration of the muscular substance of the somites on the neural aspect of the body-cavity, and the abortion of the latter in the caudal region, acquired a new mode of progression, the tail then became vertically flattened, so that the parapodia were thrown into two rows dorsally and ventrally, and finally fused as supposed above; the displacment towards the middle line of the rows of parapodia being greatly favored by the lateral movements of the tail of the ancestral form. The presence of the body-cavity and viscera anteriorly probably prevented the shifting and median concrescence of the notopodia, so that they remain near their original position as the rudiments of the paired fins.

These views may at first seem far-fetched and improbable, but when I am able to present them more fully with new data and illustrations in a special memoir[1] upon which I am now engaged, I hope to be able to show that they lead to conclusions of the greatest possible moment in scientific morphology.—*John A. Ryder.*

PHYSIOLOGY.[2]

Medical Physics.[3]—The time has come when even in America it is recognized that medical education demands for a foundation a knowledge of those general chemical and physical laws which control the history of matter in all its forms. In Germany and France special courses in physics have long formed a part of the medical curriculum, and Dr. Draper has undertaken the difficult but praiseworthy task of preparing for the English-speaking medical student a non-mathematical text-book of physics which shall present with tolerable completeness an account of matter and its laws, with special reference to their bearing on the physiological processes of the body. There are probably few scientific subjects in which the selection of material and the method of

[1] Studies on the development of the Chordata and Achordata, together with an exposition of the Archistome-theory.

[2] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

[3] By J. C. Draper, M.D., LL.D. Lea Bros. & Co., 1885.

presentation involve so much difficulty as that now considered. Dr. Draper wisely takes particular pains to expound clearly the received ideas concerning the structure and properties of matter; and especially useful, for the most part, are the frequent statements and applications of the facts of molecular mechanics.

The general division of the subject into Matter and Energy is admirable for purposes of teaching, and perspicuity of treatment has been attained with marked success.

It is unfortunate, however, that the author should have repeated from the older text-books so much that is erroneous, in his consideration of the physiology of the subject. There are few physiologists of to-day who would not read with astonishment the elaborate defense of the chemical attraction theory of the circulation advanced on p. 308. Again (p. 158), the modern lecturer has annually to deny the statement, "when breathed in the unmixed state it (oxygen) stimulates the nervous system strongly and finally causes death."

No physiological worker now considers fibrin, as such, a constituent of blood-plasma (p. 193).

We must insist that the whole idea involved in the discussion of the relation of animal tissues to oxygen (p. 206) is wrong. We were under the impression that since the labors of Helmholtz there was little cause to dispute the conclusion that the function of the auditory ossicles was to convey vibrations to the internal ear, though Dr. Draper apparently considers the question as to their function still open (p. 375).

It is to be hoped that in a subsequent edition of the work, and such will no doubt be quickly called for, these manifest blots will be eliminated.

INFLUENCE OF COCAINE, ATROPINE AND CAFFEINE ON THE HEART AND BLOOD-VESSELS.—Dr. Beyer's work was performed upon the terrapin after the most exact physiological methods.

Cocaine added to calf's blood supplied to the physiologically isolated heart first causes a slight quickening in the rhythm of the beat and an increase in the amount of work done as measured by the quantity of blood pumped out. A succeeding and more pronounced effect of the drug is a selective inhibition of the ventricular beat whose rhythm is reduced one-half, that of the auricles remaining normal. It is interesting to note that this slowing of the ventricular rhythm is not accompanied by a decrease but, on the contrary, often by an increase of work done. In large doses cocaine causes an arrest of the heart in the phase of diastole, but recovery may usually be brought about by the supply of fresh blood. Cocainized blood sent directly into the arteries and, after circulating through the vascular system collected from the venæ cavæ, produces in all doses a constriction of the smaller blood-vessels as indicated by the diminution in the amount of outflow-

ing blood. Beyer concludes that the elevation of arterial blood-pressure which follows the administration of cocaine depends upon its united stimulating effect upon the heart and the blood-vessels; a fall of blood-pressure coming on after the rise must be due to the action of cocaine on the heart alone, because its constricting effect upon the blood-vessels outlasts its stimulating action on the heart.

Like previous observers, the author found that atropine in certain doses increases the rate of heart-beat and also the amount of work done, and moreover it exercises an inhibitory influence over the contractions of the ventricle. It is argued that the action of the two drugs upon the heart is almost identical, the main difference being that the initial stage of stimulation by cocaine is much shorter and may be produced by smaller doses than is the case with atropine. The author concludes from the evidence of many data which cannot be recorded here, that the specific action of both cocaine and atropine is upon the muscular substance of the heart.

Caffeine in rather small doses increases the rate and power of heart-beat and the amount of work done. Supplied directly to the blood-vessels caffeine produces in all cases a dilatation; its total action in the uninjured animal ought, therefore, to cause the maximal amount of blood to circulate through the system in a unit of time.—*Am. Jl. Med. Sci., July, 1885.*

Restriction of Vaso-motor Excitement in Hypnotized Patients by Suggestion.— Hallucinations are readily excited in hypnotized persons when various ideas are suggested to them, but M. Dumontpallier finds that the influence of such suggestion is able also to extend itself definitely over the purely organic processes of the body.

Two hysterical patients were hypnotized and a piece of paper was held in place by a linen bandage upon the upper inner surface of each of the four limbs of either patient. It was now declared to one patient that the region under the paper upon the left leg was being blistered; while the other patient was assured that the corresponding area of the right leg was suffering the same treatment. Each patient complained, both while in the normal and in the hypnotized condition, of a burning sensation in the places to which the attention had been directed. The hypnotic condition was re-induced two or three times during forty-eight hours, and the temperature of the skin was tested by a thermometer whose bulb was passed under the bandages. In the first patient, at the end of forty-eight hours, the skin under the paper on the left leg showed a temperature elevation of 2.8° C.; in the second patient the temperature of the skin under the paper on the right leg was raised 3° above the normal at the end of one, and 2.4° at the end of two days. In the case of each

patient the area of suggestion had a higher temperature than the corresponding area of the other leg. It is concluded that by mere suggestion to a hypnotized person there may be produced in him vaso-motor dilatation over any area of the skin chosen at will.—*Comptes Rendus, T. ci, p. 228.*

KOCH'S CHOLERA BACILLUS.—M. Pouchet reports the interesting fact that he has extracted from the broth used as culture-medium for Koch's cholera-bacillus an alkaloid which appears to have all the external characters (odor, chemical instability, toxic effect upon animals) of a substance which can be isolated from choleraic dejections.—*Comptes Rendus, T. ci, p. 510.*

HEAT CENTER IN THE BRAIN.—A few years since Dr. H. C. Wood, of Philadelphia, published an extended account of researches, in which experimental support was given to the hypothesis that certain areas in the cerebral cortex act as nerve centers for the regulation of the production of animal heat. Two German students have quite recently partly confirmed these observations after a much less troublesome method than that employed by Wood. The operation is performed upon guinea-pig, rabbit or dog, and consists in passing a needle through the skull at the place of union of the sagittal and coronal sutures, some millimeters to the right or left of the longitudinal sinus. The needle is pushed in a perpendicular direction as far as the base of the skull and is then withdrawn. Succeeding this treatment there is an immediate rise of temperature throughout the body to the extent of several degrees. At the same time the frequency of respiration is slightly increased and there is diminution in the amount of chlorides in the urine, but the animal remains well and in two or three days the phenomena disappear. The operation may then be repeated with like results upon the same animal. It is not decided whether the effects described are due to the temporary stimulation of a heat-production center or to the paralysis of a heat-inhibitory center in the part of the brain which is punctured.—*Arch. f. Anat. a. Phys., 1885, p. 166.*

SPECIFIC ENERGY OF SKIN NERVES.—In a previous communication (NATURALIST, 1885, p. 417) Magnus Blix is reported to have experimentally verified the hypothesis that the sensations of heat and cold each have their appropriate nervous organs in the skin, and that author's latest researches go to show that the sense of pressure is also aroused through a third special set of sensory nerves distributed to the skin.

The sensibility of skin to pressure was tested by letting fall, by means of an elaborate apparatus, a small weight upon the surface to be investigated. In this way it was found that an area not covered by tactual hairs could be mapped out in points of various sensitiveness arranged symmetrically around certain centers of

greatest sensibility. Probably all hairs are tactile organs. On the dorsal side of the left hand the minimal stimulus for a circular group of pressure points was represented by the figure 0.23, while on certain intermediate points the force necessary to be applied in order to evoke sensation was represented by 1.5. The pressure points on the back of the hand were more sensitive than those upon the middle of the fore-arm and still more so than those upon the thigh. The skin appears most sensitive to pressure where the tactile corpuscles of Krause are most numerous. In true scar tissue neither cold, warm nor pressure points can be discovered. Many points of the skin are insensitive to pain, as tested by needle-puncture, while others are extremely susceptible. It is very probable that sensations of pain depend upon direct injury of a sensory nerve trunk.—*Zeitschr. f. Biologie, Bd. xxi, p. 145.*

PSYCHOLOGY.

Mind and Motion.—The Rede lecture delivered last week in the Senate House, at Cambridge, by Mr. G. J. Romanes, M.A., F.R.S., was entitled "Mind and Motion." After giving some account of the teaching of Hobbes, who laid it down, on the one hand, that all our knowledge of the external world is but a knowledge of motion, and, on the other, that all our acquisitions of knowledge and other acts of mind imply some kind of "motion, agitation, or alteration, which worketh in the brain," Mr. Romanes pointed out, as regards the internal world, that physiology has proved that molecular movements of nervous matter are concerned in all the processes of reflex action, sensation, perception, instinct, emotion, thought, and volition. The lecturer detailed the discoveries which of late years have been made by physiology concerning the rate at which these movements travel along nerves, the period of molecular vibrations in nerve centers, the time required for processes of thought, and the quantitative relations between brain-action and mind-action. When physiological instruments fail to take cognizance of these relations, we gain much additional insight touching the movements of nervous matter by attending to the thoughts and feelings of our own minds, for these are so many indices of what is going on in our brains. Proceeding to contemplate the mind, considered thus as a physiological instrument of the greatest delicacy, he argued that the association of ideas is but an obverse expression of the fact that when once a wave of molecular disturbance passes through any line of nerve structure, it leaves behind it a change in the structure, such that it is afterwards more easy for a similar wave when started from the same point to pursue the same course. Such being the intimate relation between brain-action and mind-action, it has become the scientifically orthodox teaching that the two stand to one another in the relation of cause to

effect. He pointed out that the doctrine of conscious automatism is logically the only possible outcome of the theory that nervous changes are the causes of bodily changes, and, therefore, it cannot be fought on grounds of physiology. If we persist in regarding the relation between brain and thought exclusively from a physiological point of view, we must of necessity be materialists. But it does not follow from this that the theory of materialism is true; and other considerations of an extra-physiological kind conclusively prove that the theory is false. We have, first, the general fact that all our knowledge of motion, and so of matter, is merely a knowledge of the modifications of mind. Therefore, so far as we are concerned, mind is necessarily prior to everything else. Thus the theory of materialism assumes that one thing is produced by another thing, in spite of an obvious demonstration that the alleged effect is necessarily prior to its cause. But further, "motion produceth nothing but motion," says Hobbes, and yet he immediately proceeds to assume that in the case of the brain it produces not only motion, but mind. Materialism has to meet the unanswerable question—How is it that in the machinery of the brain motion produces this something which is not motion? Science has now definitely proved the correlation of all the forces, and this means that if any kind of motion could produce anything else that is not motion, it would be producing what science would be bound to regard as in the strictest sense of the word a miracle; causation from brain to mind is in the strictest sense of the word a physical impossibility. *Mutatis mutandis* the theory of spiritualism—which supposes causation to proceed from mind to body—is, he held, but little less unphilosophical than the opposite theory of materialism. For just as it follows from the conservation of energy that motion can produce nothing but motion, so it equally follows that motion can be produced by nothing but motion. Is there, then, any third hypothesis in which we may hope to find intellectual rest? If we unite the elements both of spiritualism and of materialism, we obtain a product which satisfies every fact of feeling on the one hand, and of observation on the other. We have only to suppose that the antithesis between mind and motion, subject and object, is itself phenomenal or apparent, not absolute or real; that the seeming quality is relative to our modes of apprehension; and, therefore, that any change taking place in the mind and any corresponding change taking place in the brain are not really two changes, but one change. There is thus supposed to be only one stream of causation in which both motion and mind are simultaneously concerned; motion is supposed to be producing nothing but motion, mind-changes nothing but mind-changes. Both producing both simultaneously, neither could be what it is without the other, because without the other neither could be the cause which in fact it is. The use of mind to animals is thus ex-

plained, for intelligent volition is shown to be a true cause of bodily movement, seeing that the cerebration which it involves would not otherwise be possible. This monistic theory thus serves to terminate the otherwise interminable controversy on the freedom of the will; for the theory shows it to be merely a matter of terminology whether we speak of the mind or of the brain as the cause of bodily movement. That particular kind of physical activity which takes place in the brain could not take place without the occurrence of volition, and *vice versa*. All the requirements alike of the determinist and of the free-will hypotheses are thus satisfied by a synthesis which comprises them both in one. Mr. Romanes afterwards reviewed the opinions of the late Professor Clifford upon this subject, and concluded by observing that if it were true that the voice of science must of necessity speak the language of agnosticism, at least let them see to it that the language was pure; let them not tolerate any barbarisms introduced from the side of aggressive dogma. So would they find that this new grammar of thought did not admit of any constructions radically opposed to more venerable ways of thinking, and that the often-quoted words of its earliest formulator applied with special force to its latest dialects—that if a little knowledge of physiology and a little knowledge of psychology incline men to atheism, a deeper knowledge of both, and still more a deeper thought upon their relations to one another, could only lead men back to some form of religion, which, if it be more vague, will also be more worthy than that of earlier days.

ANTHROPOLOGY.[1]

FURTHER CONFIRMATION OF THE POST-MORTEM CHARACTER OF THE CRANIAL PERFORATIONS FROM MICHIGAN MOUNDS.—In a paper entitled "Burial Customs of our Aborigines," read by the writer before the Ann Arbor meeting of the American Association, August 28, 1885, two fragmentary crania, recently exhumed from a mound on the Detroit river, Michigan, and presenting good examples of the peculiar custom of cranial perforation, were exhibited as illustrations in the anthropological section. The cephalic index of the first specimen would throw it into the medium or orthocephalic group, or to follow the nomenclature of Professor Broca, the mesaticephalic division. The single circular perforation occupies, as usual, a central position at the vertex of the skull, being situated on the sagittal suture, about 0.6 of an inch back of its junction with the coronal suture. The perforation is 0.4 of an inch in diameter, and was probably made in the same manner as were all those I have seen, by a rude stone implement rotated by hand.

The second specimen is evidently not of as great antiquity as

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

the first. Its fragmentary condition, the entire occipital bone and parts of the parietal bones being wanting, prevents most of the usual measurements being taken; but though a smaller and narrower skull than the first mentioned, its cephalic index would, doubtless, place it in the same range, viz., that of the mesaticephali. It is, however, most interesting in presenting the unusual feature of having two perforations. The smaller of these, less than 0.4 of an inch in diameter, is situated on the sagittal suture, and about 0.1 of an inch back of its junction with the coronal suture. The second perforation is over 0.4 of an inch in diameter, and is placed on the frontal bone, in a straight line with the direction of the sagittal suture and 0.35 of an inch from its junction with the coronal suture. The perforations from center to center are 0.8 of an inch apart.

In my examination of these specimens I have made the important discovery that the perforations in both of them are countersunk, or made from both sides—from the inside as well as the outside of the skull. The beveled edges unquestionably settle this point, and are a further confirmation, if any such were required, as to the perforations being *post mortem*. This is a point overlooked by me in my previous studies, and, indeed, doubtless is wanting in the perfect crania, where the perforations could not well have been made except from the outside of the bone.

These two specimens present many of the characteristics observed by me in other crania I have taken from our mounds. In the second and narrower skull the outlines of the orbital cavities, wanting in the first and larger cranium, are decidedly quadrilateral; the frontal protuberances are less pronounced, and the glabella, which in the first specimen is replaced by a slight depression between the superciliary arches, is represented by the usual swelling. The first skull, which, as I have already stated, is the more ancient of the two, is further distinguished by having a small though decidedly developed epactal bone. This bone, sometimes called the "bone of the Incas," from its prevalence in ancient Peruvian skulls, I have already called attention to as occasionally pertaining to the more ancient crania from our Michigan mounds; and also to a certain inclination (if I may so describe it) to produce this bone, as though at one time some ancestors had possessed this distinctive characteristic, but that the peculiarity was gradually eliminating in the later generations, possibly through intermixture with other races.

Both of the specimens seem to have belonged to male adults, as do all others of the perforated skulls which I have observed.—*Henry Gillman, Detroit, Michigan.*

PILLING'S BIBLIOGRAPHY. — The most valuable work as yet issued by the Bureau of Ethnology is a volume bearing the following title: Proof sheets of a Bibliography of the Languages of North American Indians. By James Constantine Pilling. (Dis-

tributed only to collaborators.) Washington: Government Printing Office, 1885. [pp. 1135, gr. 8vo.] This work was commenced by Mr. Pilling several years ago, and with unflagging and systematic assiduity prosecuted amid the distractions of a laborious and exacting Government appointment. In the first place the sources of information have been exhaustively consulted from Adelung to Williams. The feeling of security and confidence is at once awakened on one's finding that the catalogues of Adelung and Vater, Alcedo, Andrade, Asher, Bartlett, Berendt, Boturini, Brinley, Brinton, Clarke, Field, Icazbalceta, Ludewig, Ramirez, Sabin, Steiger, Trumbull have all been exhausted and their personal aid in many instances has been secured. The rules of cataloguing adopted by the consensus of leading libraries have been carried out, so that in this case we have an alphabetical list of persons or societies that have written in or upon the Indian languages of North America, with full and accurate titles of all editions of their writings. This is not all. Every page of the work furnishes brief abstracts of works, the author's own statement of his purpose in his work, the annotations of distinguished critics who were conversant with the several languages. Mr. Pilling has also kept a record of his own difficulties in finding many of the publications recorded, so as to make the task of hunting, which was extremely laborious to him, easy to those who come after him. Finally, no one is omitted. If he is, it is because he has been hiding, and it will be necessary only to know of his existence to drag him into publicity in the final issue. The error is really on the other side, and many titles are included for trivial reasons. Major Powell receives from the author and richly deserves the highest commendation for the encouragement which he has given. There is, perhaps, a little too much mutual admiration between patron and author for a work of such magnitude. This is carried to a ridiculous extent when over thirty pages are given to members of the Bureau of Ethnology, one page to the Smithsonian Institution and three inches to W. W. Turner. It is to be hoped that all who are interested in American philology will call Mr. Pilling's attention to works on American Indian languages which are in the least danger of escaping his observation.

THE MOUND-BUILDERS AND THE HISTORIC INDIANS.—A very remarkable treatise upon this subject appeared last year in *Kosmos*, and now comes to us in a separate pamphlet, from the pen of Dr. E. Schmidt of Leipzig. The author starts out with the assumption that most American archæologists see in the builders of the mounds a definite ethnological unit, differing from the historic Indians in their anatomy but more in their culture. These mound-builders peopled in compact settlements the Mississippi valley, ruled by despotic government, worshiping the sun with human sacrifices in temples and altar-places, and living upon the

productions of agriculture. They were advanced in the art of spinning, weaving, metallurgy and keramic. They fortified themselves with circumvallation and buried their dead in mounds. A cataclysm cut off these people from the historic Indians who are absolutely new-comers upon the soil, as were the whites who succeeded them. Now Dr. Schmidt holds that the same revolution of sentiment which has substituted in geology a gentle and gradual evolution for the preceding notion of sudden breaks in creation will also take away the theory of mound-cataclysms and prove the continuity of social history on our continent.

One of the favorable symptoms of this change of opinion is the substitution of mound-anatomy, ochthotomy, for the older process of mound-rummaging. The NATURALIST defines anthropology to be the application of natural history methods and apparatus to human phenomena. Mound-anatomy is the application of the methods of the biological laboratory to the examination of a mound. Dr. Schmidt, after giving a good résumé of the distribution and classes of mounds, in which he always eliminates the marvelous, the extraordinary and the mythical, follows very closely Professor Putnam in his latest researches. "In truth," says he, "the mounds tell us nothing of the political organization of their builders, the sacrificial mounds are nothing more than burial tumuli for cremation. We make an absolute step in knowledge when we say that we know nothing of the sociology and religion of the mound-builders." Furthermore, in studying the geographical distribution of mounds, it is seen that special types characterize given areas. It is not to be supposed that one people acted so differently without the motive of great climatic variation. These types of remains speak of different peoples who developed their several ideas. The thousand and one perishable things that have fallen victims to time and fire more definitely expressed this separation, and the things that remain are like the few words in common throughout the Aryan tongues, telling of a common origin further back. The crania of the mound-builders are, for the most part, artificially deformed, as are those of many modern tribes of America. The time of these peoples extends from many centuries before Columbus far into the historic period of the continent.

On the other hand, when we seek to compare the mound-builders with the modern Indians, we find our ignorance almost as profound respecting the latter. Nothing is more unjust than to place in opposition an exaggerated view of the former with the most degraded types of Indians. In New England, New York, Pennsylvania, Virginia, all through the South, the early settlers were actually kept from starving by the aboriginal maize fields. In all of these self-same localities were fortifications, circumvallations, fossettes, platforms, as among the mound-builders. Did the mound-builders trace animal forms in earth? the Indians

of New Mexico paint their altars in colored sands to-day. The terraced mounds, cremation, ossuaries, stone mounds, deposit burial, art productions for peace or war, traditions of the great Eastern stocks are all ably examined by Dr. Schmidt, and wonderful parallelisms pointed out.

Finally, relying greatly upon Mr. Hale's "Indian migrations as evidenced by language," the author revives the story of the Allegewi. There's the rub. The number of American archæologists who believe that the mound-builders were not Indians at all is very small. We have never seen one. There are all grades of believers in the amount and quality of relationship between the mound-builders and historic Indians; but which mound-builders and which historic Indians, that is quite a different thing.

THE NATIVES OF NEW GUINEA.—It is usually stated that two types of man exist in New Guinea; the one Melanesian, or so-called Papuan (which prevails from Flores to New Caledonia and Fiji), occupying the bulk of the country; the other, a fairer, milder race, having decided affinities with the Polynesian, found on the south coast of the eastern peninsula. Members of the former division, however, differ widely in appearance in different parts of the island. Not only have they in some instances undergone great admixture, as, *e. g.*, on parts of the north coast, where the type has been refined by mingling with a superior and possibly immigrant strain, but elsewhere, in the interior and on the coast, as at Sorong in the north-west and on the east side of Geelvink bay very degraded types are found. The fairer race show signs of great admixture and deviation from the Polynesian type. The Papuans preserve the heads of enemies and the skulls and jawbones of relatives. The "great house," many hundred feet long, and containing several families, is found in New Guinea, as in Borneo and among the Mishmis and Nagas of Assam; the last-named having also, like the Papuans, separate houses for bachelors, and, unlike them, others for maidens. The Malay practice of building on piles is also common throughout New Guinea, even high up on the mountain sides. In the south-east stockaded villages are built on the steep spurs of hills, surmounted by a *dobbo*, serving as a watch-tower and as a refuge from human and spiritual enemies. Houses are also built on the ground with low walls and projecting eaves. In some places are larger houses, ornamented outside with figures of birds, etc., which seem to correspond to the council-house. The Papuan is a savage of a high order. Although still in the stone age the artistic faculty is shown in the carvings on canoes, houses, implements and weapons. They are fond of flowers. They trade massoi bark, nutmegs, bird skins, pearl- and tortoise-shell, trepang and slaves for cotton cloth, iron and copper ware, knives, beads, mirrors, indigo and arrack.—*C. Trotter in Proc. Roy. Geog. Soc., vi, 196.*

THE MARL BEDS OF KUNDA.—Professor C. Grewinck, in the University of Dorpat, has written a pamphlet of seventy-two pages on the marl beds of Kunda, in Estland, Province of Livonia, on the Gulf of Finland, Russia. The marl beds are three versts from the sea, between the town and the River Kunda. The first portion of the pamphlet describes the geologic features of the locality. From page twenty to the end an account is given of the bones of vertebrates and the bone implements found in the marl. The animals include *Equus caballus*, *Bos taurus*, *Cervus alces*, *Cervus capreolus*, *Cervus tarandus*, *Sus scrofa*, *Canis familiaris*. The horse and ox are most common, and are found as well in the marl as in the bog, generally gnawed. The bone implements are mostly harpoon points and piercers, and the position of the pieces is accurately described.

ANTHROPOLOGY IN JAPAN.—[Trans. As. Soc. of Japan, XI, pts. 1 and 2, XII, pt. 1].—*Food-plants in Japan.*—Mr. Edward Kinch, in the Transactions of the Royal Society of Japan, vol. XI., pp. 1–38, presents a tabulated list of the food-plants of Japan. The systematic name, the Japanese name, and, in many cases, the English name is given. The author also states the part of the plant that is useful, the use to which it is put, and any interesting facts known. Dr. Geerts makes some observations on this list and draws attention to Siebold's "Synopsis plantarum œconomicarum universi regni Japonici," Trans. Batav. Soc. of Arts and Sc., XII, and to Dr. S. Syrski's article on Japanese economic plants, pp. 175–220, in von Scherzer's Fachmanuische Berichte, etc., Stuttgart, 1872.

Ainos of Tsuishikari.—Tsuishikari is a hamlet in Sapporo, twelve miles east of the city. The Ainos who people it are a colony from Sagalin that, in 1875, at the invitation of the Japanese government, left their native island. From 1863–1875 Japan was engaged in settling with Russia her frontier in Sagalin, and ended by exchanging for the Kuriles. In 1875 she granted lands on the Ishikaro to her Sagalin subjects. Seven or eight hundred came and built their straw huts. These Ainos are fishers and live on fish, rice and pounded lily roots. Hunting the bear is their glory, and they will attack the animal with a bow and a knife. The men are fine looking, and no hairier than many Englishmen. The women and girls tattoo the cheek with the juice of the haba tree. The dress of both sexes is gaudy and not unlike. The weapons are the bow, sword, and dagger. The women smoke more than the men, and are also the musicians, playing the Jew's harp, the harp, and a two-bridged harp (*tonkare*). Their houses are no better than our Indian huts, and interiorly are furnished like them. All their home-made vessels are of wood. Bear cages are a constant adjunct for raising cubs, whose Aino mistresses suckle them when they are very young. These

home-bred bears are killed at the bear festival in September. The system of consanguinity and affinity is not well worked out. When an Aino dies, bowls of water and rice are placed by the corpse for two or three days. The body is placed in a wooden box with a pan, a cup, a sword, and a gilt rod. The burial is very retired, and the hut is not burned; on the contrary, it is allowed to remain as the residence of succeeding generations. They worship deities innumerable, every natural object furnishing one. The medicine man does not differ from the same functionary in all other tribes of their *gradus.—Mr. J. M. Dixon, in Tr. As. Soc., Japan, XI, 39–50.*

Japanese Tea.—Part I, vol. XII, pages 1–32, plates I–XXI, is devoted to a monograph on the preparation of Japan tea. By Henry Gribble.

ANTHROPOLOGICAL NEWS. — Professor F. W. Putnam draws attention to the following extract from the *American Journal of Science,* XLIV, 1843, p. 302, written by Dr. John T. Plummer of Richmond, Wayne county, Ind.: "A tusk [of the mastodon or mammoth] was exhumed from the gravel, fifteen feet below the surface, while excavating the Whitewater canal near Brookville, thirty miles south of Richmond; a club-shaped implement, formed apparently of cliff limestone, was also taken out of the gravel ten feet below the surface, near the spot where the tusk was found."——A writer in *Science* draws attention to the following sources of information respecting the aboriginal languages of S. America:

Professor Friedr. Müller in Grundzüge der Sprachwissenschaft.

Lucien Adam in Examen grammatical de seize langues américaines, Genoa, 1882.

Dr. Julius Platzmann in Glossar der Feuerländischen sprache.

Giacomo Bove in I Fuegini, secondo l'ultimo suo viaggio, Parte prima, Genova, 1883.

John Luccok, Grammatical elements and a vocabulary of the Tupi language or lingoa geral, of Brazil, Rio Janeiro. H. Laemmert & Co., 1882.

Dr. Julius Platzmann, fac-simile edition of Havestadt's book of Chilidúqu [see *Science,* III, 550].

R. B. White, A short ethnographic and linguistic study of the Indians of Antioquia and of the Cauca valley, U. S. Colombia.

J. Anthrop. Inst., &c.. 1884. [Contains vocabularies of the Noánama and Tadó dialects of the Choco family].

Edwin R. Heath, Vocabularies of Canichana, Cayuába, Mobíma, Mosetería, Pacavára, Marópa and Tacana languages of Bolivia.

Braz da Costa, Vocabulos indigenas e outros introducidos nouzo vulgar. [Foreign and Indian words introduced into the Portuguese of Brazil.]

A. H. Keane, On the Botocudos, also called Aímorés, J. Anthrop. Inst., Nov., 1883. *Botocudos* means "those wearing the lip ornament."

J. J. von Tschudi, Organismus der Kechna sprache, Leipzig. F. A. Brockhaus, 1884, pp. 534.

Giovanni Pelleschi, Sulla lingua degli Indiani Mattacchi del Gran Chacco, Frienze, 1881.

F. di la Carrera, Arte de la lingua Yunga, Lima, 1880.

——S. Carlos von Koseritz has published "Bosquejos Ethnologicos," a series of papers contributed by him in the last three years to the Gazeta de Port Alegre on anthropological subjects in the province of Rio Grande do Sul and other parts of Brazil. Stone implements of a strictly Palæolithic type appear to be very rare in von Koseritz's collection, and as they occur promiscuously with Neolithic objects, the author infers that it is impossible to determine a Palæolithic antecedent to a Neolithic age in Brazil. Many pieces were found associated with the remains of the Megatherium, "*Rhinoceros tichorinus*"(*! !*) and the cave bear. But a skeleton recently found in a shell mound on the banks of a freshwater lagoon near Cidreira, three miles from Rio Grande, convinces the writer that the early inhabitants of South Brazil were of a lower type than the Charruas and others in possession of that region in the historic period. The Botocudos of the Aimores mountains have more nearly the features of the Cidreira cranium (*Nature*, Aug. 21, 1884).——Those who are interested in the subject of the *jus prima noctis* will find it thoroughly discussed by Dr. Karl Schmidt in Zeitschrift für Ethnologie, XVII (1884), pp. 18–59. The author seems to be familiar with the literature of the subject, and gives innumerable references to authorities, ancient and modern.

MICROSCOPY.[1]

A MEANS OF DIFFERENTIATING EMBRYONIC TISSUES.—It may be safely assumed that all hardening and staining fluids possess, in a higher or lower degree, the power of *developing*, in the photographer's sense, histological distinctions between embryonic cells, long before these distinctions become manifest in perceptible morphological differences. It is evident, also, that this differentiating action varies in strength according to the conditions under which the reagents are applied. Our knowledge of the ways and means of controlling this action is still very meager; but it is sufficient to show that the histological technique of the future has much to hope for through experimentation in this direction. One of the best ways of intensifying the differential effects of hardening fluids, is to use several of them in combination or in sequence. The use of osmic acid, followed by Merkel's fluid, is an example of this kind. The advantages of this method in the study of pelagic fish eggs have already been noticed,[2] and I wish now to state briefly what the method will accomplish when applied to the eggs of Clepsine. The mode of procedure is as follows:

The eggs are placed in ¼ per cent solution of osmic acid for ten minutes, then rinsed in clean water and transferred to

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] AMERICAN NATURALIST, Nov., 1883, p. 1204, and Proc. Am. Acad. Arts and Sci., XX, p. 28, 1884.

Merkel's fluid (platinum chloride, ¼ per cent, and chromic acid, ¼ per cent, in equal parts), in which they are allowed to remain one and a half hours. They are next washed in flowing water for the same length of time, then treated with 50 per cent and 70 per cent alcohol. They need remain only a short time in the first grade of alcohol (about thirty minutes), but should be left for twelve to twenty-four hours in the second. For staining, I have used Grenacher's alcoholic borax-carmine, adding to it from one-third to one-half its volume of glycerine. The glycerine intensifies the action of the dye, so that a moderately deep stain is taken in the course of twenty-four hours.

It should be mentioned that it is best to stain immediately after the eggs have remained the required time in alcohol, as receptivity for the staining fluid diminishes considerably with the lapse of time. The osmic acid has time to penetrate to all parts of the embryo, and the blackening is arrested and partially removed by the action of Merkel's fluid. The differential effects of the osmic acid are, however, sharpened under the influence of the chrom-platinum solution.

This method has enabled me to trace out the history of the entoderm, and the precise origin of the nerve-chord, nephridia, salivary glands, larval glands, &c. The results of my study will be published in full later, and I shall here only give the more important conclusions. Each of the germ-bands, as I have shown elsewhere,[1] is made up of three distinct layers, namely: (1) an epidermal layer; (2) a layer consisting of four longitudinal rows of cells, and (3) a deeper layer, next to the yolk, composed of larger cells.

The four rows of cells, forming the layer subjacent to the epidermis, are the products of four larger cells at the posterior end of each germ-band. These four cells are called "*neuroblasts*" in the papers referred to. The innermost layer, which is wholly mesoblastic, is derived from a large "mesoblast," which lies below the four "neuroblasts." Thus the two deeper layers of each germ-band is made up of the products of five cells.

The main point to be determined was the precise origin of the nerve-chord. In my first paper dealing with this subject I was unable to settle this point satisfactorily. I satisfied myself that the nerve-chain was formed from the products of the so-called "neuroblasts," but I was mistaken in supposing that *all* of these products entered into its composition.

The method above given has shown that of the eight rows of these cells (four in each band), only the two median ones give rise to the nerve-chord. The lateral row of each band probably gives origin to muscular elements, while the two rows, lying between the median and the lateral rows, furnish the basis for the nephridial

[1] Quart. Jour. Mic. Sc., 1878, and Zool. Anz., No. 1.

organs. The two median rows of nerve-cells are faintly browned with osmic acid, while the four rows of nephridial cells are deeply browned, forming thus a sharp contrast in color. The two lateral rows are faintly stained. The development of the ganglionic chain progresses from the head backwards, so that in surface views it is easy to trace the two simple rows of nerve-cells forward into the fully outlined ganglia. The same has been done on sections, leaving no doubt as to the origin of the nerve system of the trunk. I am not able to say whether the two rows of nerve-cells extend into the cephalic lobe; but I am certain that the nerve-collar, including the supra-œsophageal ganglia, is formed from cells that lie beneath the epidermis, and not from a thickening of the epidermis itself.

The epidermis overlying the nerve-cells destined to form the four sub-œsophageal ganglia, thickens up at an early date and eventually becomes from two to three or more cells deep. This thickened portion of the epidermis has nothing whatever to do with the formation of any part of the nervous system. The deeper cells of this thickening form provisional gland-cells, which serve to attach the embryo, after its escape from the egg-membrane, to the ventral side of the parent. In this manner the young are carried about until the posterior sucker is developed sufficiently to serve as an organ of attachment. These gland-cells are colored dark brown, and are thus very easily distinguished from the lighter-colored nerve-cells lying beneath them.

The epithelium of the whole alimentary tract, excluding the stomodæum (pharynx) and proctodæum, which are derived from the epidermal layer, arises from free nuclei belonging to the three large blastomeres (*a*, *b* and *c* in my figures). The cells which form the œsophagus are the first in order of development, making their appearance just beneath the stomodæal thickening, in the very earliest stage of the germ-bands. From the mass of cells formed at this point arise not only the œsophageal epithelium, but also the salivary glands. The method employed gives preparations in which all the embryonic tissues of the head and anterior portion of the trunk (epidermis, larval gland, salivary glands, nerve-cells, muscle-cells, and œsophageal epithelium) are distinguishable.

The cells destined to form the epithelial lining of the stomach arise later than those of the œsophagus. They appear first as distinct cells, on the ventral side, at the anterior end of the future stomach, at about the time of hatching. Their development is progressive from this point backward and upward towards the dorsal side. In an embryo just hatched, I can trace these cells along nearly the anterior half of the median ventral line, and farther back I find free nuclei in the surface of the yolk. In the median dorsal line, I find no fully formed endoderm cells (except salivary gland-cells), but do find free nuclei in the anterior half.

The sense-organs of the lip arise as bulb-like thickenings of

the epidermis. At the time of hatching, long before the eyes and segmental sense-organs appear, two pairs of these sense-bulbs are found, symmetrically placed on the surface that is to form the margin of the lip. The symmetrical arrangement in pairs, the second pair being a little behind the first and farther apart, suggests that these organs were primarily strictly segmental.—*C. O. Whiman.*

Repairing Balsam Preparations.—When balsam preparations have been made with a very thin solution, or with a small amount of fluid, evaporation sometimes causes the balsam to be invaded by air spaces which it is difficult to refill, even with a thin solution of balsam. Such spaces may readily be filled with the solvent of the balsam (benzole), and then a drop of thin balsam placed at the edge of the cover glass will gradually replace the benzole as it evaporates, without leaving air spaces. To prevent a too rapid introduction of the benzole, it is desirable to transfer it with a glass tube drawn to capillary fineness at one end, rather than with a glass rod. If the tube is not too large—5 or 10^{mm}—and is drawn out quite gradually, enough benzole may be sucked into it to serve for repairing a large number of slides without danger of loss by its running out or by evaporation when the tube is laid down. The application of the capillary end of the tube to the edge of the cover glass induces a steady and even flow of the fluid, until the space beneath the cover glass is completely filled. —*E. L. Mark.*

The Eyes of Annelids.[1]—For the study of these small eyes it is necessary to make very fine sections and to remove the pigment. The decoloration of the eye may be effected by soaking in glycerine, to which a little 35 per cent caustic potash has been added. When the work of decoloring has been carried sufficiently far, it should be checked by neutralizing with dilute hydrochloric acid; and then the preparation should be carefully washed before transferring to a hardening or mounting fluid. The preparations are best preserved in glycerine.

A New Solvent of Chitin.—In a previous number of "Microscopy" I have called attention to the use of hypochlorite of potassium (KClO), or Eau de Javelle, as an agent for removing the soft parts of such animals as Spongilla, and for preparing skeletons of small animals. Dr. Looss[2] now recommends this fluid and the corresponding combination with sodium (NaClO) as excellent solvents of chitin. The thickest and hardest chitinous parts of insects, after soaking long enough to become transparent and perfectly colorless, may be quickly dissolved by boiling in one of these agents.

If the commercial fluid is diluted by adding 4-6 times its volume

[1] Graber, Archiv. f. mikr. Anat., xvii., p. 250, 1879.

[2] Zool. Anzeiger, viii, No. 196, p. 333, June, 1885.

of water, and the chitinous parts to be studied immersed (either fresh or hardened) for twenty-four hours or more, the chitin is rendered permeable to staining fluids. Nematodes and their eggs may be successfully treated in the same manner. It is remarkable that the underlying soft parts do not suffer, the finest structural conditions being preserved. The potassium compound acts with more energy than the sodium compound.

WHITE ZINC CEMENT.—This cement is recommended, by Dr. Frank L. James, as superior to those in general use for inclosing preparations mounted in glycerine. The following are his directions for preparing it:

Dissolve gum damar in pure benzol sufficient to make a solution of the consistency of a thin syrup, and filter through absorbent cotton. Into a porcelain capsule put a small quantity of chemically pure oxide of zinc, free from moisture (a precaution which is best assured by heating the zinc in a muffle for a short time prior to using it), and, having previously wet it with a small quantity of benzol, add sufficient of the damar solution to make a paste the consistency of cream or a thick paint. Rub with the muller or pestle until perfectly smooth, and then pour into a stock bottle. Repeat the operation until a sufficient amount of the cement is obtained. The fluid should now be filtered through absorbent cotton to remove all of the grosser particles of the zinc which escaped the action of the muller. It may now be allowed to stand until the zinc subsides to the bottom. If the fluid has been used in proper proportion the zinc will occupy about half of the entire mass. In other words, the fluid and zinc should be in about equal proportions. If there be too much fluid, a portion may be decanted, while if there be too little the requisite amount may be added from the damar solution. The operation is finished by adding sufficient drying oil (boiled linseed or nut oil) to give the cement a proper toughness.

The cause of the so-called "creeping" of glycerine, leakage of cells, etc., is explained by the same author, as follows:

All of the cements which I have enumerated and described in the preceding chapters, with the exception of gold size, consist of some solid material or materials dissolved or held in suspension in a medium more or less volatile, the evaporation of which again leaves a solid mass. The exception, gold size, hardens partly, though very slightly, by evaporation, its solidification depending principally upon oxidation. In the process of hardening or setting, the bulk or mass of the cement is very materially altered, a decrease in volume occurring which is proportionate to the amount of volatile matter lost in drying. *The cement shrinks.*

Now, when a cell is properly finished it must be entirely filled with the mounting medium. If it is not so filled we are bound to have air bubbles, the *bête noir* of microscopists, which are not

only unsightly, but will, in process of time, ruin the mount. If the cell walls were not entirely dry when the cell was closed, it is plain that the process of shrinkage had not yet been completed, and that it is yet to occur to a greater or less extent. What is the inevitable result? The fluid within the cell is practically incompressible, yet pressure is brought upon it. It has no space within its container into which it can retreat, and consequently it must force its way out of it. This it does slowly and gradually. It may be some time before it is noticed, but it is bound to come. The cement gives way at its weakest point, and the fluid exudes—"creeps" out. It is discovered, washed off and a fresh ring of cement applied. This puts off the evil day a while, but in a few months the process has to be repeated. Meanwhile the pressure is continuously exerted, and minute quantities of the mounting medium gradually infiltrate the walls at fresh points; the cement disintegrates, scales, and splits off. The remedy proposed is—*Never use a cell until the cement walls are thoroughly dry and hard.—Nat. Druggist, April 4, 1885.*

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SCIENTIFIC NEWS.

— The two Portuguese explorers, Captain Capello and Commander Ivens, arrived at Cape Town on July 16th, and left again soon afterwards for Mossamedes, with the intention of returning to Europe via the Congo. They have traversed a region which no European had ever set foot in, as leaving Mossamedes in March, 1884, they reached Quillimane, on the eastern coast to the south of Mozambique, in May last, having traveled over 4500 miles of territory, 3000 miles of which were previously unexplored. They discovered the sources of the Lualaba, an affluent of the Congo, which has been so frequently referred to at recent geographical discussions. They also came upon a region which is extraordinarily rich in copper, this being the district of Yaranganga, situated between the Lualaba and the Luapula. They also made a discovery which may be of great use to commerce and science. It has often been remarked that the venomous African fly, the tsetsé, which did so much mischief to cattle in the south-east of Africa, and had almost extinguished trade between Delagoa bay and the Transvaal, had totally disappeared of late. Messrs. Capello and Ivens found that this fly was still very abundant further north, and that, as had often been stated before, it was always to be seen where there were plenty of elephants. Stanley, in the course of his travels, had observed the same phenomenon, and it follows, therefore, that the region explored by the two Portuguese travelers is rich in ivory.—*English Mechanic.*

— *Editor* AMERICAN NATURALIST :—Mr. M. C. Read has called my attention to the fact that he has been misrepresented by the text as it stands printed on p. 25 of my report upon petroleum to the Census office. No one can blame a man of Mr. Read's intelligence for objecting to being made responsible for the following sentence: "Mr. Read asserted that there were several bottomless pits of petroleum beneath an intensely hard, cherty limestone, very difficult to drill." If the previous sentence is joined to the one just quoted and the words "Mr. Read" replaced by the word "who," the text would then stand as it was intended by myself. So many stupid and blundering changes were made in my text in Washington, that I am thankful no greater injustice has been done any of the numerous authors whom I have quoted. While many of these changes were discovered and the reading restored as originally written by myself, I am aware that some of them were overlooked and still remain. Very respectfully,

S. F. PECKHAM.

BRISTOL, R. I., *Oct. 5, 1885.*

— The Zoölogical Garden of Cincinnati is in a flourishing condition, and has some especial points of attraction. It possesses probably the finest mandrill in the world. He is twelve years old, and presents, from year to year, without diminution, the gorgeous colors which the adult male only exhibits. The largest polar and grizzly bears in America are in the collection, and there is a fine Thibetan bear. Among birds there is the Mantchurian pheasant (*Crossoptilum mantchuricum*), a species we have not previously seen in any American garden.

— The St. Louis Botanical Garden, or Shaw's Garden, is a feature of that city which deserves imitation elsewhere. It was established and is sustained by the liberality of Mr. Shaw, a private citizen. Full representations of the species of several of the genera peculiar to our south-western regions are to be found there, *e. g.*, yucca and agave. A fine private collection of plants is that of Mr. Wm. Brown. His palm house and fern house are highly ornamental, while in another house nearly if not quite all the species of Nepenthes are represented.

— Charles Wright, of Wethersfield, the well-known botanical collector, who graduated at Yale College in 1835, died suddenly of heart disease Aug. 11th, aged seventy-four years. Mr. Wright was one of the leading botanists of the country. He was employed by the Government in an expedition to Texas and Arizona and had also botanically explored Cuba. Last year Harvard College secured his collection of plants. Several American plants are named after him. He was formerly a valued contributor to the AMERICAN NATURALIST.

— The *Geological Magazine* is now twenty-one years old, and in view of the great usefulness of the magazine and the unrequited labors of the chief editor, Dr. H. Woodward, in charge of the palæontological department of the British Museum, his friends are subscribing funds to present him with a testimonial, of which a piece of plate will form a part. We should be happy to receive and forward any subscriptions from friends of the editor in the United States.

— We are glad to learn, from an article by Dr. C. T. Hudson in the Journal of the Royal Microscopical Society, that a monograph of the Rotifera, by Mr. P. H. Gosse and himself, is in course of preparation. Such a work will be warmly welcomed by microscopists in this country.

— Professor W. C. Kerr, State geologist of North Carolina for eighteen years, and more recently connected with the United States Geological Survey, died at Asheville, N. C., Aug. 9th, of consumption. He was an excellent observer and a most genial, companionable man.

— Dr. Henry William Reichardt, professor of botany in the University of Vienna, died while in a fit of temporary insanity lately. The majority of his papers were published in the Journal of the Vienna Academy. He was born at Iglau in 1835.

—Messrs. M. Schlosser and Otto Meyer, of the Yale College Museum of Palæontology, have returned to Germany. These gentlemen have made important contributions to geology and palæontology.

— Professor Worsae, the distinguished Danish archæologist and curator of the vast museum at Copenhagen, died in August.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, June 9.—Mr. Ford referred to the presence of *Littorina irrorata* at South Atlantic City, and stated his belief that there were but three generations of the species at that locality. He also exhibited specimens of *Exogyra forniculata* from Kansas, the first examples of the species known to have been collected in the State.

Dr. G. A. Koenig described a mineral allied to franklinite, and found at Franklin, N. J. The zinc of franklinite is replaced by iron to such an extent as to reduce it from twenty or thirty to one and a half per cent, the manganese remaining unchanged. He proposed to name it manganoferrite.

June 30.—Dr. H. C. McCook gave an account of the life-history of the seventeen-year locust.

Professor W. B. Scott presented for publication an article upon *Cervalces americanus*, the fossil deer, from the Quaternary of New Jersey.

July 14.—Mr. Chas. Morris, referring to a criticism upon his recently published paper on the development of the hard parts of fossils, stated that the usually received idea of the organic origin of Archæan limestones was but an opinion. At the present time many springs were depositing carbonate of lime mechanically, and it is possible, and even probable, that the Laurentian seas contained as great an excess of this salt as do these modern springs. Professor T. Sterry Hunt is of this opinion, and considers the phosphates as also of mechanical deposition. Inorganic chemistry was probably much more active at that period than now, and reactions may have taken place of which no trace remains except in the conditions of these early strata.

July 28.—Mr. G. H. Parker described the anatomy of the Cecropia moth. The proboscis is small and the œsophagus thread-like, indicating that the imago takes little nourishment. The speaker stated his conviction that the three glands which pour a secretion into the oviduct, and the function of which was by a recent writer said to be unknown, secrete an adhesive material which serves to secure the eggs to the object on which they are deposited.

Linnæan Society, Lancaster, Pa., June 27.—There were a large number of donations to the museum, among them a specimen of the nest of the Tarantula, containing the insect, from California, by Abram Summy; and the habitaculums of the Cicada from the Moravian burying-ground, donated by S. M. Sener. They are not as perfect as those secured in 1868 on the premises of George Hensel. This is perhaps owing to the character of the soil. Those of the former year were found in a soil of clay and sand, whilst those in the burying-ground were in a dark, loamy soil. This is an interesting confirmation of an observation that had heretofore never been recorded except in reference to Lancaster city.

It was announced that the twenty-four new plants collected in Lancaster county last year, by W. P. King, are in the hands of Dr. T. C. Porter, who determines them to be correctly named. Miss Baker exhibited specimens of "lychee," a fruit sold by the Chinese.

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THE STONE AX IN VERMONT.

I. CELTS.

BY PROFESSOR GEO. H. PERKINS.

THOSE specimens usually termed stone axes, for whatever purpose designed by their makers, may be grouped under the three heads, celt or ungrooved ax, notched ax and grooved ax. To the first group, the celts, by far the larger number of our ax-like implements, must be referred, and of this alone will the following pages treat, other varieties of the ax being deferred until a second paper. This term celt is convenient rather than accurately descriptive, embracing, as it usually does, a great variety of objects which undoubtedly were put to a variety of uses. We might easily set aside some of our celts as axes, others as chisels and still others as skin-dressers, or adzes, or hoes, but in most cases this definite assignment is wholly theoretical, and hence very possibly erroneous. Moreover, when we attempt to arrange a large series of these implements under the various groups, we soon discover numerous intermediate forms by which all may be united into a nearly unbroken series. There can be no doubt that there were certain uses for which some implements were especially intended, and other uses which others were to serve. Nor can there be any doubt that when occasion required, the same implement served for several sorts of work. For our present purpose it will be most convenient to call all our ungrooved axes celts.

As compared with other classes of implements celts are not uncommon in our Vermont collections, and they exhibit a

remarkable diversity in form, size, material and workmanship. Scarcely any two of them are precisely alike, and among them may be found European forms like some of those figured by Evans, Lubbock, Dawkins and others, as well as forms identical in all essential respects with specimens from various portions of the United States. Any one who studies stone implements from different countries must notice the prevalence of certain common types which are repeated in locality after locality, and in ancient and modern work alike.

Very likely the celt had its origin in the hammer stone. This, at first a well-worn pebble with no wrought surface, was, after a time, rubbed on another bit of stone until at one end a rude edge was obtained. When this was accomplished the hammer had become an ax. The one tool of its kind possessed by early man, it served many purposes, and gradually took upon itself a great variety of forms.

It was a simple and rude beginning, but it was one of the first steps in that far-reaching series by which man has risen from savagery to civilization.

Very rude celts, such as are sometimes found in other localities, are not common in Vermont collections. A pebble merely rubbed at one end until an edge was obtained is not usually the form found; far more commonly the entire surface is hammered, and not seldom smoothed and polished. Some of our best celts are not excelled by our finest specimens of any sort in elegance of form or finish. Almost all the more common kinds of rock found in Vermont appear in the celts, but some kinds are more often found than others, these are trap, greenstone, granite, mica schist and talcose schist; less common are quartzite, porphyry, serpentine, slate, etc. The hollow chisel, or gouge, is connected with the celt by certain peculiar forms which are sharpened like a chisel at one end while the other is hollowed.[1] So too we find gouges in which the hollow is very slight, and in some scarcely noticeable. There is a great diversity in the curvature of the edge of our celts, a perfectly straight edge being never found, and a close approximation to it is not common. In the great majority of our specimens the curvature is considerable, much more than is seen in a modern ax. As the celt is connected with the gouge by certain specimens, so it passes into the regularly

[1] See this journal, Vol. xv, p. 433, Fig. 6.

grooved ax through others. In some specimens there is merely a notch on each side, in others a very slight groove, and so on till we have the typical grooved ax. The form of some of the celts renders the supposition that they were furnished with a handle very improbable, but others undoubtedly were attached, some in one way some in another, to a wooden handle. Whether the prehistoric Vermonter ever adopted the Australian custom of imbedding the blunt end of his ax in a mass of pitch is not to be known, but the material for such a handle was at hand and may have been used.

The average celt of the Champlain valley is about five inches long or a little more, and half as wide. The extremes are found in little hand axes not more than three inches long, and large and sometimes clumsy specimens twelve inches long, and rarely more. In the thickness there is found little relation to other dimensions; some of the longest celts are thinner than many of the shorter ones. In most cases the thickness is greatest near the middle of the length, though sometimes the thickness increases from the edge to the other end. The edge is always carefully worked, however rude the rest of the specimen, and it rarely shows the effects of hard usage. Most of the specimens are hammered over the entire surface, and not seldom they are smoothed and polished, but some are left just as they were cleft from a large mass, and show no sign of the workman except at the edge. In many respects archæological specimens from New England are greatly surpassed by those from the mounds of the West and other localities, but some of our Vermont celts will bear comparison with similar objects from any part of this country or Europe. A very few copper celts have been found in Vermont, but none of any other material except stone, and of these latter only will this article treat.

Without pretending to establish a permanent classification of these objects, but only for present convenience, they will be considered in several groups, which will be determined chiefly by form. Our first group will include such as are linear in outline, the length being several times the width. Some of these are of large size and rude in finish, while others are carefully finished, and in a very few cases there is an attempt at carving in the form of one or more knobs or ridges. Fig. 1 illustrates this variety, and in this as in the other figures, the design is to exhibit an

average specimen of each class. The smallest celt of this class which I have seen is four and a half inches long, but most are much larger. A few of these linear celts are quite thin, in one case the material is common roofing slate of nearly uniform thickness and chisel-like form, and this implement could never have been intended for use as an ax, since the first blow would probably have shattered it. In these celts we find often each of the wide surfaces flat, but in others, and this is the case with a majority of all classes, one surface is flat or nearly so, while the

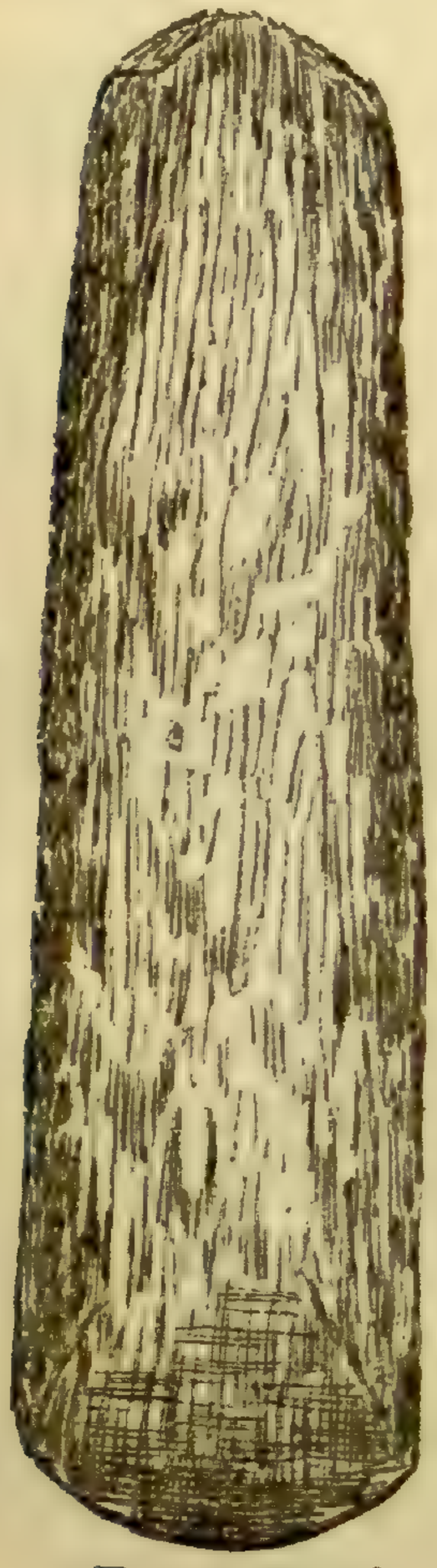

FIG. 1. × ½

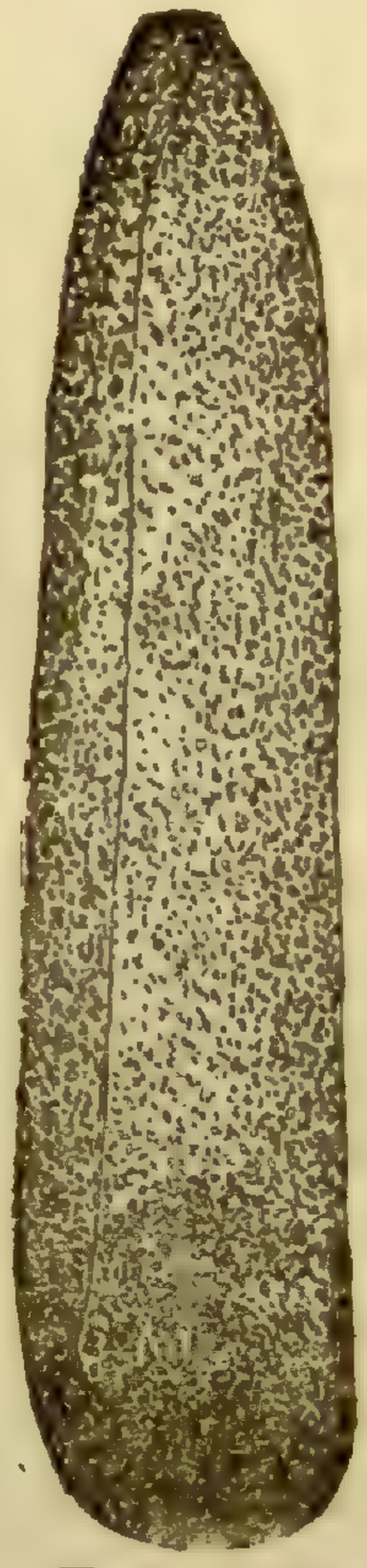

FIG. 2. × ½

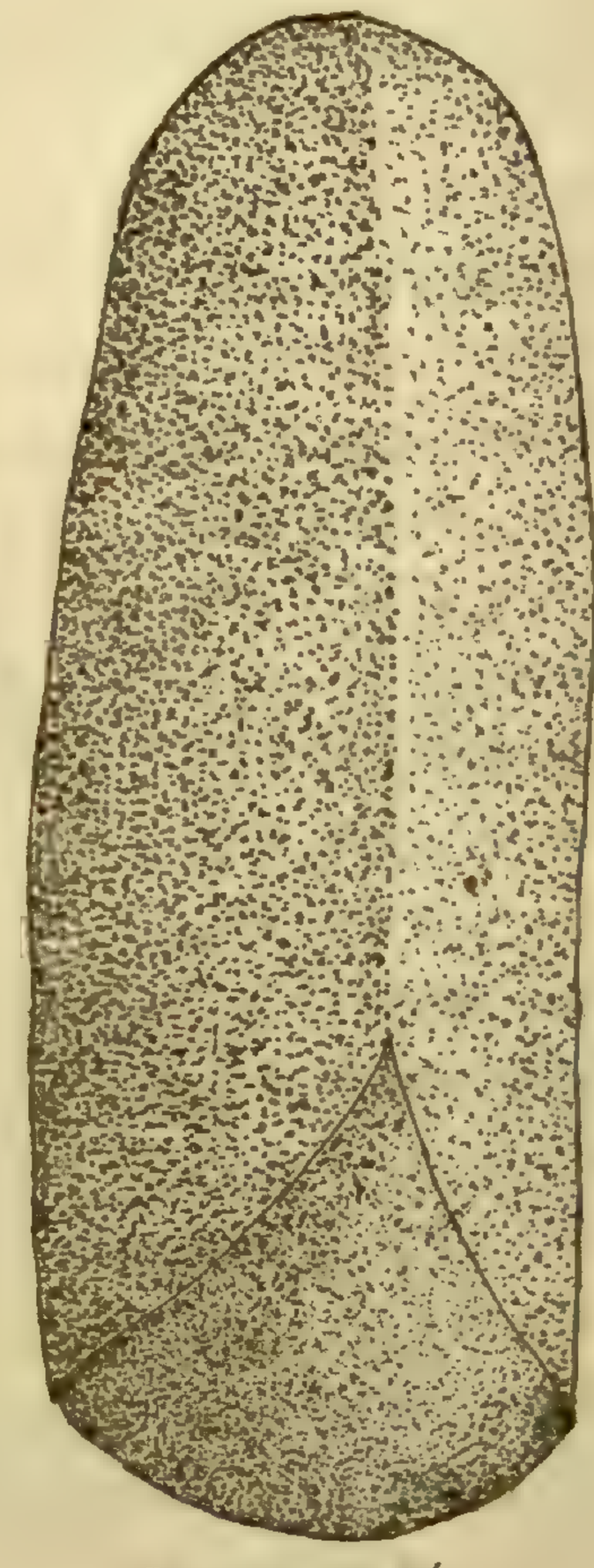

FIG. 3. × ½

other is more or less strongly convex. The flat surface is usually more highly polished than the other.

In Fig. 2 we have a very unique example of the linear celt, both ends being sharpened and one transversely to the other. It is not common to find each end ground to an edge, but I have seen only this specimen in which the line of one edge crossed that of the other. It is a very finely made implement of compact basalt. It was found several feet below the surface in the subsoil, in Weybridge, by Mr. A. J. Stowe. It is nearly six inches long and about one inch in greatest width.

Still another type of celt is shown in Fig. 3, which was found in the same locality. The usually flat surfaces are beveled from a median ridge, as shown in the figure, to the sides. The material is a greenish quartzite and the specimen is very well finished, though not as well as many. It is six and a half inches long, two and a half wide and rather more than one inch in thickness.

The second class of celts are quadrangular in outline. Some of these are large and rude, others small and well made, but as a class they are rude and apparently made for rough work. In some cases, however, they are not strong, but, as in case of the specimen shown in Fig. 4, the material is some sort of slate, and too brittle for other than light work. Much larger specimens of this sort than that shown in Fig. 4, which is only four inches long, occur. One of these is of bluish serpentine, and was polished over the entire surface, although it was not worked smooth, and hence retains the irregularities made by the cleavage. It is nine inches long and more than four wide.

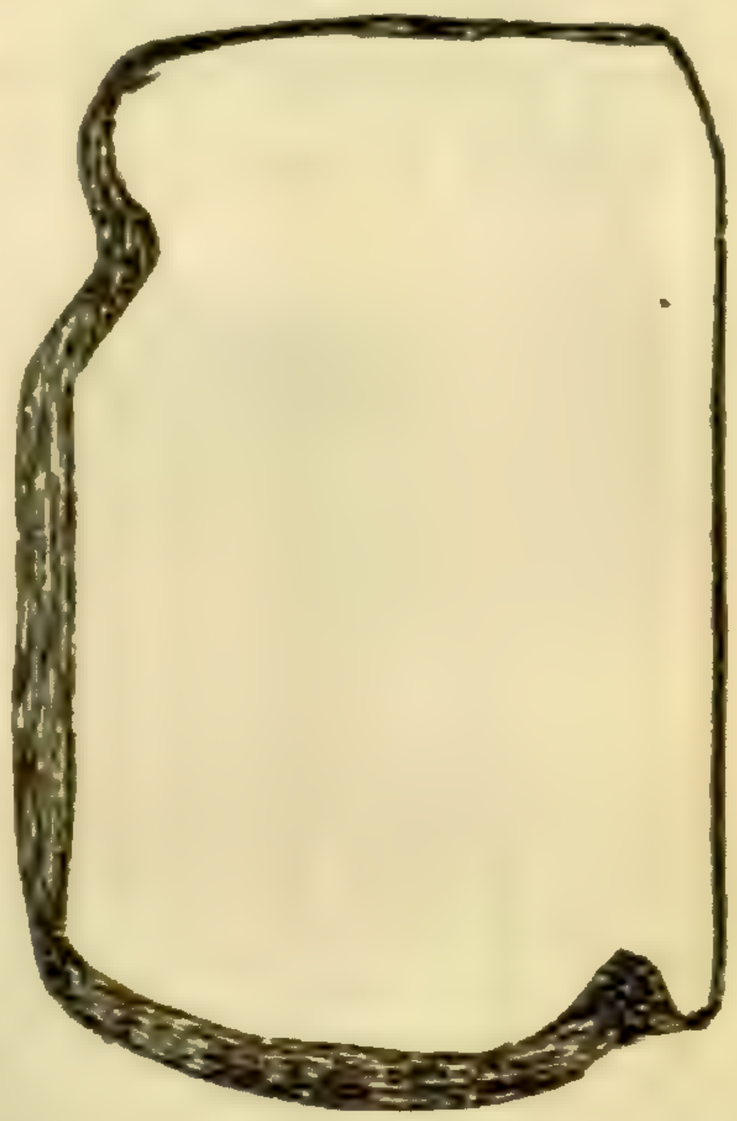

Fig. 4. × ½

On page 433 of Volume xv of this journal, figure 6, is shown a specimen which illustrates the general form of the typical celt of this class, only substituting for the concave end an edge like the upper one in the figure. Very many are ground to an edge at each end, and these are much more carefully made than others which have but one edge.

Fig. 5 shows a type of our third class of celts, those which are quadrangular in outline but narrower at one end than the other, and the narrow end, if there is but one edge, is always that which is blunt. Often in celts of this form each end is brought to an edge, as in the case of Fig. 5, though this is less common than in celts of the second class. These celts are mostly very nicely made and of handsome material, and often beautifully polished. Some of them resemble closely the small celts found in the Swiss lakes. For the most part they are not of large size, averaging, perhaps, three or four inches in length. In none of our stone implements do we find

more beautiful specimens of ancient workmanship than in these celts, some of which, made from a compact, fine-grained serpentine of richly shaded green, are most elegant objects.

There are beds of this handsome material in several localities in the State, and it is remarkable that no objects made from it have been found except some of the celts. Most of the celts of the second and third groups are much wider than thick, but a few are either cylindrical or quadrangular in cross-section. The globular form seen in celts from other localities never appears in Vermont. Our celts appear to have been mainly worked from pieces split from larger masses rather than as in some places from pebbles. A form of celt which may be regarded as a modification of that shown in Fig. 5 is shown in Fig. 6. This is obviously a hand ax, and although made from porphyry is finely smoothed and polished. Possibly this is one of those specimens of which Lafiteau speaks when he says that they were not finished during a single lifetime, but were handed down as heirlooms to be highly valued. Certainly no short time would be sufficient for the manufacture of so perfect an implement from so hard a stone. This specimen is four and a half inches in length and two and a half in width across the edge. In cross-section it is oval.

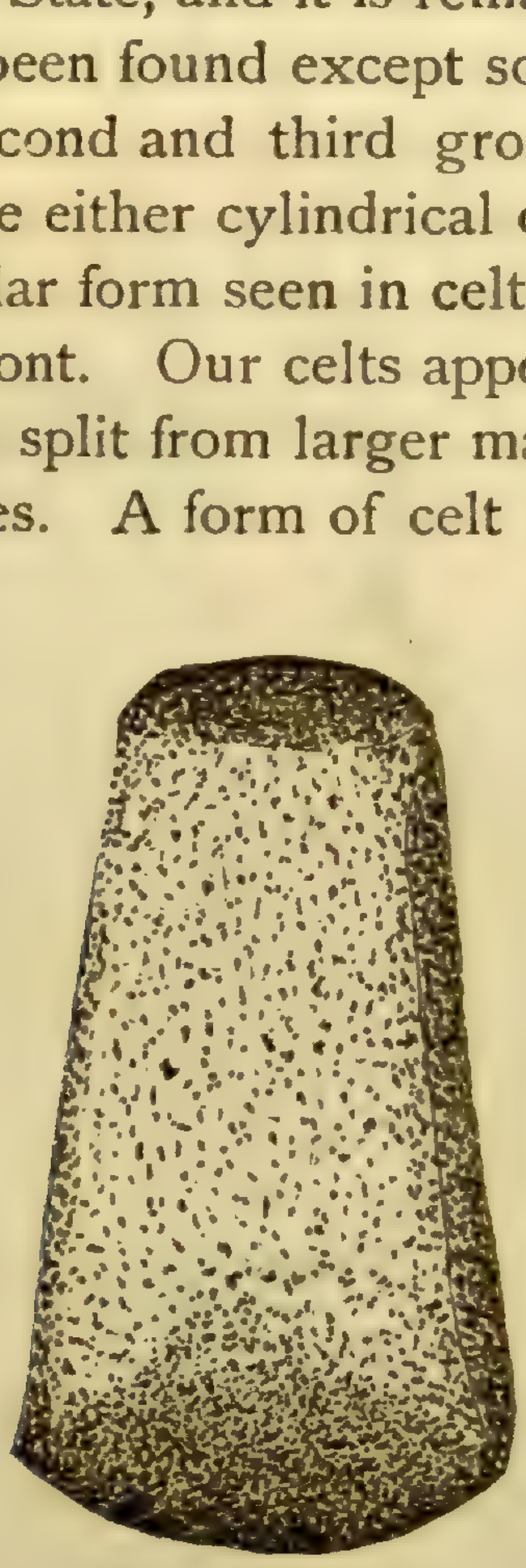

FIG. 5. × ½

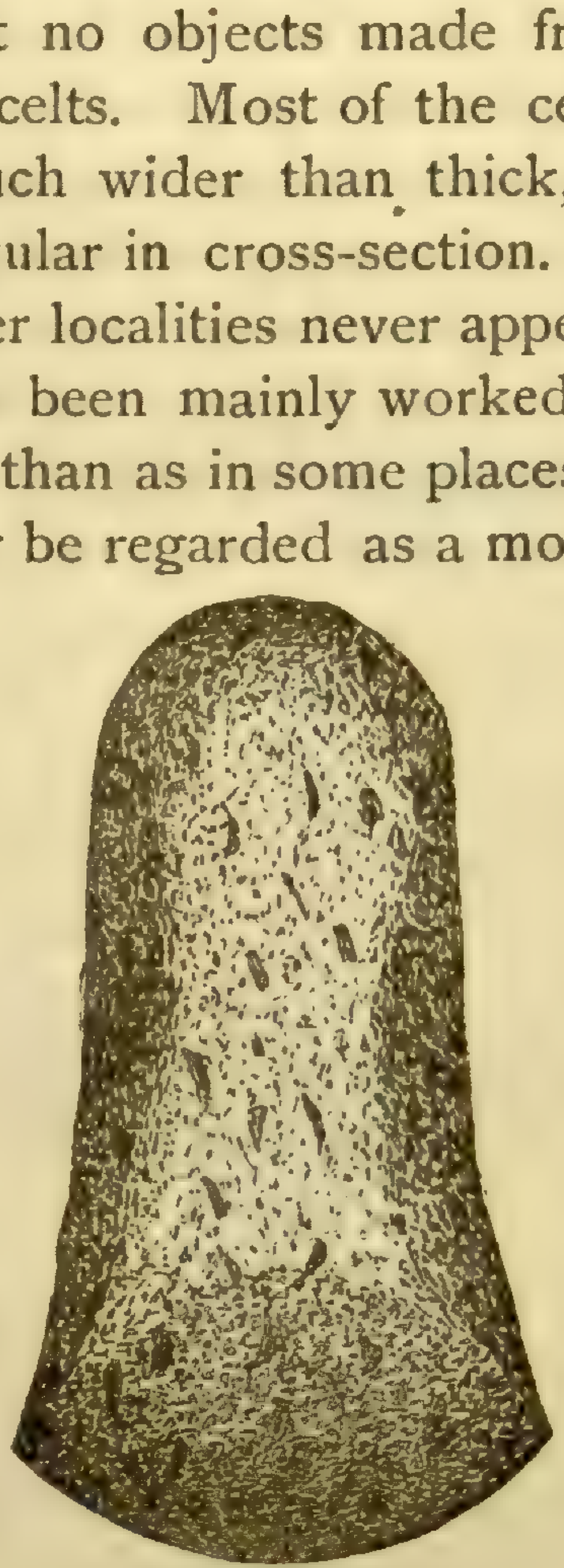

FIG. 6. × ½

Celts of our fourth class are triangular, as is that shown in Fig. 7. Some of these are rude, others finely wrought. The specimen figured is a very beautiful example of this type of celt. It is made of dark brown clay-ironstone marked by a band of

lighter shade. It is very smooth, and the edge is unusually sharp. Both surfaces are quite flat. It is nearly five inches long and three across the edge. Celts of this form are less common than those of the other classes, and are usually of medium size and of hard, compact material, such as quartz, of which several are made, or porphyry. They are almost always made with great care, and even those of granular quartz are polished about the edge and sometimes over the entire surface. As any collector of stone implements will readily believe, there are many celts in our Vermont collections which do not clearly come within any one of the above groups, but are intermediate in their character. Nevertheless there are very few which cannot be placed in one or another of the four classes with sufficient accuracy for a general description. It is rather remarkable that so few of our celts show broken or worn edges. Some of them do indeed bear abundant evidence of severe service, but most have sharp even edges as if only just from the maker's hand. Either the larger part of these implements were skin-dressers, fleshers and the like, as doubtless some of them were, or if used for any work that broke or defaced the edge, they were very promptly repaired, and that this was sometimes done is familiar to every collector. The shape or bevel of the edge is by no means uniform. In some of our specimens the angle inclosing the edge is very large, and the bevel abrupt and short, as in many of our modern tools used by iron workers, while in others it is less abrupt, and in most quite like the edge of our modern ax, for which at best the celt could have been only a very indifferent substitute, although as a flesher or skinning knife or scraper some of the forms may very well have served most excellently.

FIG. 7. × ½

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 1076, November number.)

VII. The Physical Basis of Mind.

THAT the mind has a substantial basis does not need an attempt at argument before a scientific audience. The necessity of this is already fully admitted. For those who are not scientists the arguments we have already given must suffice. The claim that the brain is the organ of mind is based almost solely on this necessity. No other substance is perceptible at the apparent seat of thought, and the cerebrum is claimed as this seat in spite of the insuperable difficulties in the way of such a theory.

Yet there is much substance and much in substance which we cannot hope to ever perceive. Our senses are very imperfect instruments, and make us aware of but a minor portion of what exists. Our most important sense, that of sight, is blind to the great realm of gaseous matter. The microscope reveals to us worlds of existence which the unassisted senses could never have discovered. By the aid of delicate tests and instruments many of the less gross and active conditions of matter have been made apparent. In this way the range of our sensibility has been very greatly increased. And yet we are but on the threshold of the universe. Important conditions exist to which the senses of man have never responded. Important conditions exist to which our physical senses can never respond. We have the strongest reason to believe in the existence of substance all around us of which we can never become sensible.

Some review of the conditions under which substance appears to exist becomes here requisite. In the science of a century past matter was but one of several distinct forms of substance. It was accompanied by a number of *ethers*, or imponderable essences, one each for heat, electricity, magnetism, &c. Indeed, the facility with which a new ether could be constructed to meet every new phenomenon of energy threatened in time to produce a condition as cumbrous as the old epicycle theory of astronomy. That was set aside by the discovery that the earth was a moving instead of a resting body, and the ethers similarly vanished when it was discovered that motion was the distinguishing feature in them all. From this readiness to manufacture ethers the pendu-

lum of belief swung to its opposite side, and a general incredulity on the whole subject of ethers succeeded. In more recent times this incredulity is giving way, and our most skillful physicists are fully persuaded of the existence of one ether, the medium of light radiations. To those scientists the universe contains two distinct substances, matter and ether, which differ radically in their conditions of existence.

Students of the phenomena of light declare that there is no possible escape from this conclusion. Interstellar space is probably occupied by ordinary matter in a state of extreme diffusion, and it might be conjectured that the rays of light could make their way through this substance from star to star. Science declares that this is impossible. Matter, under such circumstances, must be a very rare gas, and no gas can transmit transverse vibrations like those of light. Its degree of diffusion also would be far too great and too irregular. To transmit the rays of light some substance is needed that is very elastic; that, while exceedingly rare, is far more dense than diffused matter would be in interstellar space; and that is in the condition of a rigid solid instead of a free gas. Yet it must be a solid so readily permeable as to present no resistance whatever to the movement of the spheres. As a ball will sink with little resistance through a thin jelly, without leaving a mark of its passage, so must a globe be able to plunge unopposed through the almost infinitely thin jelly of the ether.

Ether has never been seen, felt, weighed or measured. It is absolutely invisible and intangible. No vessel has pores so minute as to confine it. It has properties seemingly contradictory; it must be excessively rare yet perfectly elastic; its physical state must resemble that of the solid while its density is immensely less. We have no proof of its existence resembling our proofs of the existence of matter, yet we are forced to believe in it because physical science cannot possibly do without it. There are hundreds of phenomena which cannot be explained without it, but can readily be explained with it.

Sir William Thomson, in his lecture before the Franklin Institute during the 1884 meeting of the American Association for the Advancement of Science, said of this intangible necessity: "You may regard the existence of a luminiferous ether as a reality of science." "One thing we are sure of, and that is the

reality and substantiality of the luminiferous ether." And he proceeds to say that it is the only thing we are confident of in dynamics. This ether he describes as an elastic solid, its rigidity enormous in proportion to its density. As to whether it possesses weight or not he declares that there is no evidence for or against.

J. Clerk Maxwell speaks as strongly on the subject, and finds a new use for the ether, as the medium of electric and magnetic energy. He advances a theory, which has met with much favor, that "light is an electro-magnetic phenomenon." In other words, both these modes of traveling energy employ the same medium and are carried by it with a rapidity extraordinarily greater than any known movements of vibrations in matter, such as the waves of sound. Ether, therefore, is supposed to permeate all substances, however dense. It conveys electricity through the densest solids, and light through the densest transparents. We can reduce air, by the air pump, to one hundred thousandth of its volume, and yet it is firmly held in a glass vessel. But light passes through the vessel, and through its partial vacuum, without a check. The substance which carries it moves as freely as if no other substance was present.

There is, however, a seeming relation between matter and ether, if we accept the latest atomic theory, that of vortex motion, propounded by Sir William Thomson. It is not necessary here to explain this theory; it will suffice to say that it holds that fragments of the ether possess a vortical motion by which they become separate and indestructible integers. Each such vortex atom must have always existed and must always exist. They are indestructible and unchangeable. No new ones can arise, and no old ones can vanish. They must be coëternal with ether. Their substance is the same as the ether itself. They are simply portions of ether affected with a certain mode of motion. But as thus constituted they are essentially distinct from ether, and the two constitute two unlike conditions of substance. This conclusion is probably true whatever the character of atoms, and whether the vortex atom theory be correct or not.

Professor Oliver Lodge gives the following particulars concerning this substance.[1] The density of ether, though small, is

[1] The Ether and its Functions, *Nature*, Jan. 25, 1883.

enormously greater than that of the earth's atmosphere can be if the atmosphere extends indefinitely into space, as is highly probable. The rigidity of ether is insignificant as compared with ordinary solids, yet its transmitting power is enormously greater than that of steel or glass, on account of its very slight density. The ether within glass transmits vibrations 40,000 times as rapidly as the particles of glass itself could do. But the atmospheric ether carries these vibrations at a speed one-half greater. The speed, therefore, is checked within glass to two-thirds its normal amount. Why is this? Is ether affected by gross matter, and concentrated by attraction so as to increase its density? Fresnel's hypothesis is, that the ether is really denser inside gross matter. He thinks that an attraction exists between ether and the molecules of matter which results in an agglomeration or binding of some ether round each atom, and that this bound ether belongs to the matter and travels with it. The free ether may flow without check through the pores of matter, and even through those of the earth as it dashes onward through space. Refraction of light from such a cause is attributed to bound ether, which seems to act differently on the different colors.

Certain experiments have been tried to prove whether any of the ether can be bound. If ether is carried along with a moving stream, as of water, it should hasten the speed of light passing through that stream. If not carried by the stream there could be no effect on the speed of light. The results of these experiments have been favorable to the hypothesis. Yet the variation in the speed of light from such a cause is so slight that it is difficult to reach any very positive conclusions on this subject.

That ether possesses energy is unquestionable. It moves with such extreme readiness that it cannot fail to possess a large sum of normal motions. Its physical condition also is indicative of conditions of energy. Elasticity, rigidity, solidity are due in matter to the interactions of attraction and motion, and we have no warrant to ascribe them to any other cause in ether. But the motions normal to ether are certainly very different from those normal to matter, since ether refuses to accept the motions communicated to it by matter. This is what we must understand from radiant light and heat. Matter forces its motions upon ether, but the latter substance refuses to absorb them, and merely transfers them, with the utmost rapidity, to some distant mass of

matter. We know that the sun exists because its energy is transmitted to the earth by the ether, and acts upon the matter of the earth. Were not the ether a perfect transparent to this material energy we could never become aware of the existence of sun and stars, since their light and heat-rays would be swallowed up long before they could reach us.

Ether is, in fact, the most homogeneous body in the universe. It is in a state of motor equilibrium, its motions probably being exceedingly more rapid than those of ordinary matter. It has no direct motor relations with matter, but transmits to distant matter all motion forced upon it, by aid of the vibrations of its particles or separate portions, which are localized in position, like those of the solid. J. Clerk Maxwell speaks of it as follows: "Whether this vast homogeneous mass of isotropic matter is fitted not only to be a medium of physical interaction between distant bodies, and to fulfill other physical functions of which, perhaps, we have as yet no conception, but also, as the authors of the *Unseen Universe* seem to suggest, to constitute the material organism of beings exercising functions of life and mind as high as or higher than ours at present, is a question far transcending the limits of physical speculation."[1]

Not having read the Unseen Universe, I am unaware of the precise character of its speculations, yet I cannot imagine the luminiferous ether as possessed of such powers. For life and mind organization seems necessary, and organized ether is distinct from free ether, and must be some condition analogous to matter, which is probably one form of organized ether. Bound ether, or atom atmosphere, may represent such a second state of organized ether. For all we know to the contrary a second series of atoms may be formed by this condensing action of matter on ether, atoms intimately connected with matter and assimilated with it in motion, yet differing in density of substance and motor rapidity. It may be possible that several series of such atoms exist between matter and ether, each capable of forming a basis of life and mind. Whether originating independently, or each rarer series formed by the condensing action of a denser series, the energies emitted by the atoms of one series could not act on those of another series. Free ether would serve as a medium for the vibrations of them all, but the vibrations yielded by each would pass unresisted through the substance of every other series,

[1] Article "Ether," Encyclopædia Britannica.

and only be absorbed by substance of the same series. The range of material vibrations seems to be from about a hundred million million, or perhaps lower, to sixteen hundred million million pulsations per second. The slowest vibration emitted by an atom of rarer constitution might lie above this speed, and range upward from this point of rapidity.[1]

It is with the bound ether that we are here concerned, that which, in the opinion of many able scientists, surrounds material atoms and molecules like an atmosphere. The existence of such an ethereal atmosphere carries with it the implication of some conformity in motion between the atom and its atmosphere on the same general principle that operates in the case of the earth's atmosphere. And the condensing relation between the atom and its atmosphere can hardly be any other than that of attraction. Yet it does not necessarily follow that the motions of the bound ether must be in every respect identical with those of the atom it surrounds. A motor leverage doubtless exists between them, but leverage of a different character may act on this bound ether from without. It may possess special motor conditions of its own, as the terrestrial atmosphere while possessing the general motions of the earth has special motions which are not shared by the solid matter of the earth's mass.

These conclusions seem almost necessary deductions from the widely accepted view, above given, of the relations of matter and ether. There is another conclusion, at which we have already hinted, not a necessary yet a conceivable consequence. This is, that bound ether may, under certain favoring conditions, attain an organized state not dependent upon that of matter, and be capable of permanently retaining this condition. If, as is probable, molecules composed of many atoms possess an ethereal atmosphere, then the disruption of the molecule need not necessarily disrupt its associated ether. Though ether is organizable under the influence of matter, yet the forces which disrupt gross matter might, in certain cases, become powerless upon ether. If so, a mass of ether which had been organized by the influence of a mass of matter might retain that organization unimpaired after

[1] For an able and elaborate treatment of this subject see Professor A. S. Herschel's letters in *Nature*, Vol. 27, pp. 458, 504, and Vol. 28, p. 294. These were written in answers to articles by the writer on "The Matter of Space," and constitute an important treatise on the constitution of the ether, its relations to matter, and its possible atomic variations.

the material mass had become disintegrated, and might continue to exist as a molecule or mass of a constitution much more rare than that of matter.

Possibly this power of becoming independent does not exist in the case of atomic or molecular atmospheres of bound ether. But it may do so in the case of the bound ether of more developed compounds. We may look upon the crystal, the plant, the animal, even on the body of man as possessing, in addition to the free ether that readily permeates them, a mass of condensed or bound ether which reproduces every detail of their organization and every specialty of their motion, from that of each atom to that of the organism as a whole. In such a case the cerebrum might possess such an ethereal atmosphere, not only reproducing it in organization, but affected in its motor relations by every impulse received from without which is not consumed as muscular motion. There are certain good reasons for believing that such a psychic substance exists, intermediate in condition between matter and ether, and sending out vibratory energy like that of matter. This psychic substance yields no energies which can affect matter at a distance, and it is not affected by the emitted energies of distant matter. It can affect matter and be affected by it only while an intimate connection exists, like that between the cerebrum and its psychic atmosphere, and only through the agency of this connection. In this relation the psychic substance assumes the general motor conditions of the cerebrum, with which it is so intimately associated, and is also sensitive to special motor conditions coming from distant matter. It is, therefore, organized by the conditions of energy in the material universe. It, in addition, gains special motions through its own interactions, and impresses these upon the universe. As compared with matter its substance is excessively rare and its motions excessively rapid. Its mobility is therefore extreme, and its susceptibility to new influences far beyond anything existing in matter. Finally it may be capable of retaining its organization separate from matter, its constitution being such that the disrupting energies which destroy the organization of matter are powerless to affect the psychic organism, they being repelled from its surface, or passing through it as innocuous vibrations. Under some such conditions, and such only, can we comprehend the existence of a physical basis of mind. And thus only can we conceive the

possibility of the existence of the mind after the disruption of the body, in substance absolutely imperceptible to our senses, yet forming organisms which may be as evident and substantial to each other as are our material bodies to each other.

So far all this is pure hypothesis. We have only offered as evidence for the existence of a psychic substance the seeming incapability of the brain to serve as a mental basis. Yet other evidence exists of considerable force and value. We know that a psychic substance must exist for the same reasons that we know an ether exists. We cannot see, touch or weigh either, but there are phenomena in nature which we cannot possibly comprehend without them. We believe in the ether because there are things done in the universe which matter could not possibly do. We may find ourselves forced to believe in a psychic substance for reasons of the same kind.

If masses of matter send out radiations of light and heat which affect distant masses of matter, then psychic masses, when actively excited, should send out parallel radiations which will affect other psychic masses, but fail to act upon matter. Evidence of the existence of such a condition is by no means rare. Every mind seems to send out psychic radiations which flow like light rays through ether in every direction, weakening with distance. At least by such a hypothesis we can understand some very remarkable mental phenomena which now stand as incomprehensible mysteries. These we can but briefly glance at. One very common instance of this, which has occurred to most people, is the tendency to think and speak of a person immediately before he appears. Some indication of his coming seems to be in the air, but as an influence that acts not on the senses but directly on the mind. In certain instances persons declare that they can see a mental image of every approaching friend. If our hypothesis be true, it must be that every mind sends out radiations peculiar to itself, as every physical object does, that this peculiarity is recognized by the receptive mind, and consciousness directed thereby to the mental image of the person to whom the emissive mind belongs, precisely as it would if we saw some physical object belonging to that person.

When the emissive mind is actively exercised and is strongly thinking of the receptive person, this influence may be carried to much greater distances, and may rouse the consciousness of the

person thought of at thousands of miles away. We shall give, further on, an instance of this kind. The psychic rays may be viewed as preserving the record of their source at any distance, as in the star beams we can read the story of the physical constitution of the star, however enormously distant.

Another less common phase of this action is the tendency for two persons to speak simultaneously of the same thing. This is of various strength in various cases. One lady tells me that she formerly had a girl for companion in whose presence she did not dare to think of anything she wished kept secret, for the girl was exceedingly apt to speak of anything the instant she had thought of it. The power to make a person turn by fixing a steady gaze upon him is of this same general character. Numerous instances of these more ordinary phases of psychic intercommunication might be adduced, but we shall here mention them only in this brief manner.

One thing is evident, even in these phases of the subject, that there are great differences between the emissive and receptive power of different persons. This becomes much more marked in special cases of psychic influence. It may be to some extent, a question of transparency and opacity. We know what very great differences exist in the conductive powers of different substances for electricity. Psychic radiations may find like variations in the physical conditions of different individuals. From one mind they may flow out as through a transparent. In others they may be more or less resisted by the matter of the body. In some cases the resistance may be complete. Reception may present the same variations, a sensitive or medium being one who is unusually receptive of these vibrations. Such an idea would explain the vigorous mesmeric controlling power of some minds and the ready yielding to mesmeric control of others. And on the principle that nerve currents flow most easily along a familiar channel, we may understand the special rapport between certain operators and sensitives. In this case the body substance of the sensitive has grown specially transparent to the psychic emanations of the operator, while it may be more or less opaque to the emanations of other minds.

As to the evidence of a more decided character than that above given of psychic intercommunication, a vast volume of incidents might be offered. But the great sum of these lack the

essential element of scientific precision of investigation. It will be best, therefore, to confine ourselves to the results attained by the London Society of Psychic Research, since the experiments of this society have been conducted under strict test conditions, and the reputation of its members as working scientists gives a weight of credibility to their testimony. After the elimination of every imaginable source of error, results were attained which seem to prove incontestibly the direct intercommunication of mind with mind. These results are given in full detail in the published Proceedings of the society, but can be only briefly glanced at here. They consist of what is called thought transfer, mesmeric experiments, phenomena of apparitions and other strange conditions of mental manifestation.

In the thought transfer experiments we have striking evidence of the action of mind on mind without the aid of the senses. In these experiments objects, numbers, &c., were named, and drawings reproduced with no other guide than the mental concentration of the persons who alone knew the character of the object or drawing. The successful results formed so large a percentage of the whole as to leave chance quite out of the category. There seemed no room for doubt that the thought in the mind of the impressing persons had directly acted on the mind of the sensitive, without possible sensory connection. In explanation of these and other phenomena, Messrs. Gurney and Meyers offer a theory of telepathy, or direct communication of mind with mind without sensory aid. But their theory is imperfect in that it lacks the conception of any physical medium of intercommunication as here advocated.

(*To be continued.*)

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FLOODS, THEIR HISTORY AND RELATIONS.

BY WILLIAM HOSEA BALLOU.

FLOODS vary in their intensity and duration according to their geographical range. There are two great flood ranges in the United States lying nearly at right angles, one of duration and the other of intensity. The first is the Mississippi river and its confluents, and the second the Ohio and tributaries.

The Mississippi and Missouri rivers lie in a north and south line, and their floods are continuous from early spring until the middle of July, on account of the slow advance of the sun's heat

into the northern mountain and lake sources. While the floods thus formed are never of great height comparatively, yet their long continuation and force are means of most potent destruction.

The Ohio flood range is the most terrible on the earth's surface. The water waves generated by it surpass in height, size and power the greatest tidal waves of the ocean. All atmospheric destruction by tornado, simoon, whirlwind and waterspout, and all the damage done through subterranean upheavals by volcano and earthquake do not compare with the ravages of the floods of this river. Here is a stream lying nearly parallel with the equator, every portion of which is simultaneously affected by the sun's heat. When the temperate zone is turned toward the sun in the spring, the Ohio's ice, its entire drainage area and all its sources are let loose at once, and a sudden and awful destruction follows. At this time the Ohio is not a tributary of the Mississippi; the latter is its confluent. Its gigantic projectile of water, often 100 feet high, 600 feet broad and 300 miles long, is hurled on its mission of obliteration, sweeping before it cities, towns, forests, farms, levees, live stock, shipping and humanity. When it reaches Cairo it is re-enforced by the gradually forming floods of the Mississippi and Missouri, and there begins its unlocking of gigantic ice gorges which greatly increase its destructiveness. To protect the riparian country from these floods and repair their damages, the United States has expended $500,000,000. The individual losses sustained probably amount to twice that sum.

There is an intimate connection between floods and business. High floods and low business go hand in hand. The present financial depression was directly precipitated and perhaps caused solely by the last great flood at Cincinnati. That city was then—as in every spring time—largely in debt to New York, Chicago and other commercial centers, for merchandise. Owing to the condition of the roads and the losses of small riparian and dependent towns and cities from the flood, the Southern merchants could not collect on the products supplied by the North. They were therefore obliged to renew their notes. Then mercantile failures in the South precipitated a total loss on these notes, and the bankrupt era began to spread over the country. A large area of the South soon ceased to become a market for the North, cut-

ting off a part of the business of the latter and projecting a general stagnation. Capital, which otherwise would have gone South (which at that time was almost the sole region of investment) to aid in its development, was locked up in safe-deposit vaults and Government bonds, causing a bank scare and many bank failures. The depression soon spread to England and other countries. A retrospective glance into American history shows that great Ohio floods and great financial crises have gone hand in hand.

It is evident that having spent an entire century in trying, with no lasting effect, to repair damages done by floods, the country should turn its attention exclusively to their prevention. The methods of prevention are simple but expensive. Numerous reservoirs should be constructed among the springs in the hills, and little lakes in which to lock up the water. Great forests should be planted about the sources of the Ohio which will hold snow and ice unmelted for a long period, and allow it to escape slowly. In this way the sun will be made powerless to unloose the entire Ohio flood range at once, and the waters held subject to national control.

Congress has considered the question in its usual manner. It overlooked the facts presented above, and empowered the Engineer department to make surveys at the headwaters of the Mississippi for reservoirs. It might as well have gone to the headwaters of the Ganges, which have about as much to do with the destructive elements of these floods. It dropped $60,000 into this project and then dropped the subject. The future battle is the Ohio, not in Northern Minnesota or the moon. Congress will find it cheaper to purchase the land sources of the Ohio and its confluents, plant them with forests and wall them, than to plaster broken levees.

Professor Swing, of Chicago, has suggested that the high mounds of the mound-builders were used as protection against cyclones. He was obviously mistaken. There are no high mounds in cyclonic areas. We find them exclusively in riparian connection, where they were evidently intended for use in time of floods. These mounds were nowhere used to dwell in. None are found with entrances or hollowed out. When opened they either contain skeletons, implements, relics, pottery or nothing at all. Those unoccupied show that the owner fled or was captured

or was slain before his natural death, so that he could not be buried in his own tomb. The high mounds in the valleys served both to protect the dead from floods and as watch-towers in time of danger.

One of the remarkable aspects of floods is their influence on the formation of valleys. Nowhere is this more clearly shown than in the valley of the Mississippi below Cairo, over which the floods distribute themselves to a width exceeding forty miles in many places. This valley has a bed of alluvial silt deposited in past flood times increasing from forty feet at Omaha and Dubuque to 300 feet at and below New Orleans. In other words, the flood alluvial deposit of the Mississippi covers 80,000 square miles to an average depth of 170 feet, a surface equal to Montana. In this elastic valley the floods annually work out the destiny of the river's bed, which is often found miles from its previous course after high water.

The ice-gorges which dam up the rivers and hold back the waters for hundreds of miles are another destructive factor of floods. When they break the resulting destruction is enormous. Congress has only to supply its existing snag-boats with dynamite in order to destroy these before the damage force is accumulated. The Government signal service along the rivers can give warning of their formation.

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THE PROBLEM OF THE SOARING BIRD.

BY I. LANCASTER.

(Continued from p. 1058, November number.)

AS soaring is a phenomenon dependent entirely on bird and air, which are not connected with the earth, to avoid confusion it is best to pay no attention to the latter. For instance, a bird motionless in regard to a point on the earth facing a five-mile-per-hour breeze; the same bird moving in calm air at the rate of five miles per hour, or going with the wind at the rate of ten miles per hour, are identical in character so far as soaring is concerned. In each case the wind is meeting the bird at the rate of five miles per hour, and the differences of translation over the earth are accidental, not concerned with the mechanical activities of flight.

A bird resting in a minimum breeze cannot fall to the rear without descending; neither can it rise vertically nor at any angle obliquely to the rear. It can draw forward on the air at any speed, and when the minimum is exceeded, can then fall to the rear, or rise until the minimum is once more reached. At the minimum velocity the bird's wings are stretched to their extreme limit and the angle of inclination is the greatest. As the breeze stiffens, the bird, if it remains in the same place, flexes its pinions and reduces its incline. The frigate bird will float in a storm with not more than one-quarter of its wing surfaces exposed. Sometimes it bends the points of its wings downwards until they meet underneath.

The positions of the stretched wings in regard to a level with the body of the bird also varies. Those of the frigate bird will average level, the buzzards will be above and the gannets below a level.

For at least three hundred days in the year these birds could be observed in the air, and when the attention was given to their actions for a considerable time, at all seasons, and in the various situations found on so varied a coast as that between Tampa bay and the Capes of Florida, not only the habitual methods common to ordinary soaring flight, but the unusual ones, incidentally performed to meet some emergency, were witnessed. The birds also have periodic seasons of feeling which puts them on behavior that in a man would be thought idiotic. The months of February and March, the time of breeding, are prolific in these singular air-tumbling performances. They served to emphasize the complete difference between active and fixed wing flight.

Being informed by parties from Charlotte's harbor that sand-hill cranes could be found there, I sat out in search of them. An outside passage of thirty miles was required, which was safely made, and at nightfall I was among the Gasparilla keys. The wind being favorable and the weather fair, I kept on the outer beach, and at length drifted through a pass with the swiftly running tide in company with innumerable sharks, porpoises and fish, great and small, all headed for the bay. Rounding the point I threw over the anchor, and enveloped in a blanket with face towards the stars, slept, as one who manages a small boat for twenty hours can sleep. About daylight I was awakened by the thumping of the mast against the limb of a stunted cedar tree obliquely

jutting from the bank, and while adjusting the trouble a well-known cry sounded far above in the air, which at once banished all desire to sleep. I knew the note quite well. It denoted the arrival of sandhill, or whooping, cranes from the north. Twenty-five years before I had seen them on the western prairies lift themselves on fixed wings above the clouds, and I had no doubt but what the call proceeded from birds which had the evening before been in the region of the great lakes of our northern boundary. Before sunrise at least fifty had arrived, and were greeted by their comrades on the land in the interior of the key. They came down in great circles from a height of not less than three miles, on tensely stretched wings, until within 200 feet of the earth, when they suddenly began a slow flapping which continued to the ground. I had often seen them begin their migrations, but never before witnessed the ending. They would average a weight of ten pounds, with about eight square feet of wing surface. In rising they slowly beat the air until a suitable elevation is reached, when they assume a fixed position and continue their upward flight in great circles to a high altitude, when they swing off at a tangent for the south. I have never seen one of these birds move its wings after stopping them in its ascent, until they had arrived at the same level in alighting.

The buzzards were the best species for observation from the ground. Their patience was simply inexhaustible. I watched a small flock of these birds for fourteen consecutive hours while they floated in the breeze, waiting my removal from a dead porpoise stranded on the beach. Nothing could surpass the loveliness of the day nor the bland freshness of the incoming breeze. The birds would average eight feet in spread of wings, would weigh six pounds, and have about six square feet of wing surface. A memorandum book was filled with notes of the day's experience. About a score of flaps were made between twelve and three o'clock in the afternoon when the wind was quite active and filled with flaws. From four to six in the evening they were as motionless as if petrified. As the sun disappeared behind the waters of the Gulf, I ended the hardest day's work I ever made, and was not fifty feet away before every bird had its beak in the carcass. For several days after this really imprudent exertion of the attention I was abed, but on resuming the subject determined to try an experiment. Before my eyes, assisted by a very good

glass, several bodies, of six pounds weight each, had remained stationary in free air about thirty feet above the water, absolutely without any visible support. They had remained in that condition many hours, facing a breeze of velocity varying from five to twenty-five miles per hour. In the rear was located my device for determining horizontality of wind, and it was level the entire day. Most people would be less surprised at a body resting in this way in calm air than in wind. They would hold each to be simply impossible, but more mysterious that both gravity and air-resistance should be ignored, than simply gravity. So to determine how much force it would take to keep six pounds in air all the time unsupported, I provided a billet of wood of that weight, well rounded, and proceeded to throw it up in still air, and the moment it came down, catch and return it. The work was honestly done; the moment it descended it was tossed back with all the activity I was capable of commanding. I prefer that each one should try this for themselves, and will only say that an hour of such work was far, very far, beyond my muscular capacity.

These birds were often watched from a perch in some lonely tree at the water line. That I could recline at ease in the fragrant foliage of the pine was easily accounted for; the trunk of the sturdy tree antagonized the gravitating force of my body, and I could rest at peace. But what held up the birds? Had gravity ceased to act upon them? Had they no resistance to offer to that sea-born breeze?

After about four years of this kind of work accident favored me. A summer whirlwind, on a calm morning, issued from among the lemon trees straggling over the point a few hundred yards below, and clutching an armful of dead leaves made for the bay obliquely in front of my station in the tree. A pair of buzzards were returning from the outer beach on fixed wings, and as luck would have it, were intercepted by the cyclone, and in five seconds were ducked in the waters of the bay. I hope they possessed a sense of humor, but they seemed to blame me for the mishap. A more thoroughly laughable episode I never witnessed, and from the bottom of my heart forgave the creatures for their seeming injustice. They abandoned that part of the coast but left their secret behind them.

For the purposes of this paper enough has now been said as to the facts exhibited. It is very evident that a state of things has

been found to exist which calls for something better than guess-work in way of explanation. Taking the case of a ten-pound bird with tensely stretched and motionless wings, facing a breeze anywhere from two to one hundred miles per hour, and resting serenely over the same spot of earth, without effort and without fatigue, we find our habitual notions about the difficulty of keeping unsupported substances in the air at fault. We want a solution of the matter from the standpoint of the mechanical engineer. We need not go into the domain of molecular physics for answers, but we wish the bird explained in the same way that a steam-engine is explained when we examine it as a machine doing work. To this end we may ask three questions, and satisfactory answers being found thereto, the phenomenon will be comprehended.

1. From whence is derived the motive power to balance gravity?

2. From whence is derived the motive power to hold the bird against the wind?

3. How are these forces applied?

To explain a steam-engine in this same sense but two questions demand answer.

1. From whence comes the motive power to drive the piston?

2. How is this force applied?

When we say that the force which moves the engine comes from the coal that is burning in the furnace, and is conducted through pipes by the medium of steam to a movable piston which it sets in motion, we have, in a general way, given an explanation to the activities there going on. When we say that the grindstone is operated by the force derived from the muscular organization of the boy turning it, then its action is also explained briefly.

It is in this way that an attempt will be made to explain a soaring bird. No objection is taken to the view that force cannot produce motion, held by some recent scientists. Granted that nothing but motion can produce motion, and I am then only concerned with the sequence of events; with having it understood that the motion of the piston is not the cause of the burning coal, nor that the grindstone turns the boy.

When the trifling tornado struck the birds as above related, the mechanical activities going on between bird and air were

thrown into confusion, and the gravitating force of the bird's mass instantly carried it to the water. It was evident that the internal adjustments to environing conditions, going on through a line of ancestry reaching to the reptiles of the secondary age, omitted summer cyclones. They were too rare to count. It was also pretty clear that the gravity of the bird's mass was the source of the entire motive power concerned in the act of soaring.

Were we dealing with wind-mills, sailing vessels, tornadoes or any other phenomenon in which the air was one factor and a body connected with the earth the other, the force would properly be spoken of as coming from the air. The amount of force would vary with the velocity of the wind. The work done would be referred to the mechanical agency which set the air in motion. But a body suspended in free air is part of the atmosphere, and at rest with it, unless it employs some activity not derived from it. The same mechanical agent which moves the air equally moves the body. The active birds derive the force to move themselves in the air from their muscular efforts, the soaring birds from gravity. Gravity gives *all* the motive power; that which antagonizes itself and that which antagonizes air resistance. The case is analogous to that of a man on a moving train of cars. He is at rest with the train throughout unless he employs muscular power to set up motion with it. All activity between man and car is due to the man's force and not to the train's force. His force works a pair of legs which set up motion. Gravity works in a different way. It requires a device which compresses air as found in the soaring birds.

Notice also that the mechanical action known as "soaring" takes place only between the minimum and maximum velocities with which body and air meet. An initial impulse is required in all cases to carry the body within those limits. In a calm, the body would have to be pushed on the air until the minimum was reached. In a breeze it would be forcibly held to reach the same result. The first impulse resembles pushing an engine off of the dead center. It simply starts the machine. It has nothing whatever to do with its continuous running. Once within the limits of "soaring," the gravitating force of the body gives a liberal supply of power for all the purposes of air navigation.

Let us suppose the wing surfaces to be twelve inches in width and the bird to weigh ten pounds, with wing expanse sufficient

to soar in wind moving at the rate of thirty feet per second horizontally. Why does not the body fall? It is true that there is a stiff wind moving against it horizontally, but the gravitating force is vertical and can be in no way influenced by a horizontal force. The ball shot from a level cannon falls precisely as fast as one dropped from the mouth of the gun. It is evident that the body is indifferent to the horizontal air. This does not act upon it at all. No particle of air influences it but what is in contact with its surface, and the instant it is in contact it ceases to be horizontal, being deflected in numberless different directions. In a strict sense, in a sense which alone represents the true character of this phenomenon, the air can only be considered as quiescent in every case of soaring. In every case the air is a dead calm until it comes in actual contact with the body, and the movement of the body on the air is a consequence of force derived from the body and not from the air. It is a parallel case with the boy and grindstone. From the reciprocal nature of action and reaction, the air is doing as much work on the bird as the latter is on the air. The grindstone is doing as much work on the boy as he is on the grindstone, still it would never do to say that the latter turned the boy.

If gravity, then, be the motive power of a soaring bird, how does it act to produce the results? Vertically downwards towards the center of the earth precisely as it does in all other cases, and the reason that the body manifesting it does not get lower, is because something is pushing up, against the under surface, just hard enough to balance the weight. It may be hard to follow all the peculiarities of the disturbances going on under the bird, but it is certain that they serve to hold it up. They are mainly condensations of air upon which the body is falling, and are equal to ten pounds in each foot of air passing to the rear. This ten pounds of force is moving at the rate of thirty feet per second, as we assumed at the start, and it follows that an amount capable of holding up 300 pounds each second is passing the rear edge of the bird's wings and is wasted in falling to the tension of the surrounding air.

But this is not all the force of disturbance which passes to the rear. The reactions against air resistance also go there. These, like the others, consist in condensations, accelerations and deflections. According to the law of the composition and resolution

of forces they bear the same relation to the vertical disturbances which the height of the incline bears to the base, or, in other words, they are to each other as the angle of inclination of the resolving planes. Supposing in this case the height to be one-fifth the base, there would be 360 pounds of force passing the rear of the bird's wing each second. Gravity puts in 300 pounds and gets itself supported in doing it. The weight is thus balanced; but we are employing an external force of sixty pounds to push the body on the air. By the law of the action of elastic fluids under pressure, when the condensed air passes the rear edge of the wing surfaces it expands in all directions, and consequently upwards and forwards on that edge. If sixty pounds of the whole 360 expanding is thus thrown forwards, it will balance air resistance, and the total power to produce the soaring phenomenon will be the weight of the bird. It only requires one-sixth of the whole force on hand to do it. If this can be utilized by wasting the other five-sixths the task is accomplished. There would be waste in eddies and side currents, so that in reality there would be less than the total force of disturbance passing to the rear. Allowance may be freely made for all wastage and sufficient will remain to perform the desired service. Experiment shows that in very critical tests the result can be attained without the rear expansion. It may be held that each molecule of air as it is struck by the plane is, to some extent, carried with it, as well as condensed, while those below are at rest. Thus a rotary motion may be supposed to take place on the entire lower surface, when the air-resistance factor would be neutralized by the excess of gravity in each molecule instead of at the rear edge.

It has been objected that this is a disguised form of "perpetual motion." Remember that there is a great difference between heaping absurdity on a thing and finding absurdity in it. It is urged that gravity can only do work by the fall of the body manifesting it, and that in this case it does not fall; that there is no sacrifice of its energy of position, and hence it cannot do work. This is true of actions in which the earth, or anything fast to or supported by it, is a part, and the gravitating body another part; and it is true in the sense that the word "fall" means getting nearer the earth. But this is not true with soaring nor with allied phenomena, and I will illustrate the matter by an example. Suppose that our hypothetical bird rests in the air in a horizontal

position and that the wind moves vertically upwards against it at the rate of twenty feet per second. To get the attention on the significant features of the case, we will suppose the bird to weigh the same as the air which it displaces, thus obliterating the gravity factor. It will then have no motion with respect to the air, but will move with it. In this condition it is not a falling body, and is doing no work. It is simply a body resting motionless in air. We will now suppose ten pounds of weight to be added to it. It instantly becomes a gravitating body doing work on the air. Its motion is accelerated until a velocity is reached at which the work done on the air is equal to the force doing it, when its motion becomes uniform. Suppose this to be twenty feet per second. What have we? A case precisely analogous to that of a soaring bird, which is a falling body doing work on the air without losing its energy of position. Its "fall" is properly related, in a strictly scientific sense, to that upon which it is moving, and upon which it is doing work. In relation to the earth, or the moon, or the seven stars it may be at rest, as they are not even remotely concerned in the matter.

A soaring bird may therefore be considered a machine for disturbing air. The motive power required for driving the mechanism is its gravitating force. Its effectiveness consists in the amount of disturbance which returns to the normal condition of the surrounding atmosphere.

There are two peculiarities connected with its action, which may be considered accidental or rather incidental, which deserve attention, for they are of the first importance in all questions relating to artificial air navigation. One of them is, that the material upon which the machine does work becomes the frame which supports it, and which is not connected with the earth in any way. The other is, that while the motion of the device is in all cases in two directions on the air upon which it operates, viz., in the direction of the gravitating force and at right angles to it, in respect to the earth's surface its motion is in any direction whatever indifferently. These two unique characteristics of soaring constitute its value for artifical use. They are the results of the action of an inclined plane driven on air, and meet the requirements of atmospheric translation completely, so far as the direction of motion and supply of motive power is concerned. It effectually disposes of balloons to antagonize gravity, and of

motors to drive the machine against the air. Two requirements are still needed. The device must be steered and kept in position. When it is remembered that the rear expansion drives the bird forward, any change in the extent or position of one wing which is not shared by the other would retard or accelerate the motion of the changed side relatively to the other, and serve to determine the direction of motion. A balance still needs to be preserved. The bird gives significant hints here also. The heavier it is the steadier is its motion, and a device large enough to sustain the weight of a man may be qualified by its inertia to assist in preserving its own equipoise.

The most important points of this subject have now been given. Experiments with artificially induced currents of air, requiring a steam-engine to be transported to the sands of Florida, were expensive and productive of only negative results. Much time and means were wasted in this way, and all my efforts previous to the summer cyclone above recited seemed abortive, excepting in the settlement of the facts of soaring as shown by the birds. The moment the idea that gravity was the motive power and not the air, was entertained, the whole matter became luminous. No steps subsequently taken have been in the wrong direction, and I shall return to the prosecution of the subject the moment prudence permits.

The relation of the soaring birds to artificial air-navigation fills the whole subject with a sort of pathos. A turkey-buzzard, most despised of all the birds, employs mechanical activities by using a device of such simplicity that compared to it a common grindstone is a complex machine, for the purposes of air-locomotion in the search for carrion, with conspicuous and complete success, itself being a working model of the very thing which man has worked, and sweated, and died to possess, and he has never seen it!

For a period of time coëval with his own existence on this planet this thing has been going on, and the world is full of it now, and still the mature conviction of both common sense and science is, that it is impossible.

THE SIGNIFICANCE OF THE "COLLAR BONE" IN THE MAMMALIA.

BY SPENCER TROTTER, M.D.

WHEN running through a series of forms in animal life a structure is found fully developed in some and in others rudimentary or entirely wanting, we are led to consider the causes acting upon the structure through the life of the animal which has brought about the condition of development or non-development present. Every fully developed tissue in an organism is needed or it would not be there; and just so soon as by increasing change in life and habits, it becomes a factor of less and less importance to the animal; it fails more and more to attain its former standard of development, and in time falls back to the primitive condition from which it arose and finally disappears.

The "collar bone," or clavicle is an unstable factor in the shoulder girdle; by this I mean an element not always found present throughout vertebrates, and its presence, absence or rudimentary condition, is in relation to the life of the animal.

In this article it is my intention to note, principally among the mammals, the relation which the clavicle bears to the various modes of life, but before taking up the consideration of individual forms, reviewing briefly the general anatomy of the part.

The shoulder girdle consists first of the scapula, or "shoulder blade," a more or less irregular plate of bone preformed in cartilage and ossifying from two centers, the dorsal or scapular, the ventral or coracoid, in position against the anterior thoracic ribs, its long axis varying in inclination.

Its ventral end terminates in the "glenoid cavity," a ridge and process, *spinous* and *acromion*, on its outer surface are more or less developed in different forms, and in all mammals above the Ornithodelphia the coracoid is reduced to a mere process.

Second, the clavicle, when present, preformed in fibrous tissue extends as a bar of bone from the acromion process above the glenoid cavity to the manubrium sterni, forming a strong support to the girdle and an extended surface for ligamentous and muscular attachments. Mechanically considered the shoulder girdle (by using the term "girdle" both sides of the body are implied) is nothing more than the fulcrum of which the fore limb is the lever of the third kind, and its specialization is in direct relation

to the amount and character of the work done. The clavicle first appears in the ganoid fishes as a secondary apparatus developed in connection with the primary cartilaginous scapular arch. In the teleost or bony fishes it becomes a more important element in the shoulder girdle, having connection with the skull and the opposite sides joining in the ventral median line.

It undergoes a reduction and becomes of less significance in Amphibia and Reptilia, but in birds it assumes an important position in relation to flight, the entire shoulder girdle in fact being specialized to meet the conditions incident to aërial locomotion. The coracoids—large, strong bones—act as braces; the clavicles, peculiarly modified, are united at their sternal ends into one bone, the furculum, or "merry thought," which, as Owen has pointed out, acts as an elastic, bony arch opposing the force incident upon the downward stroke of the wing in flight, thus aiding the humeri, or arm bones, to regain their former position in the succeeding upward or counter stroke with as little loss of time and energy as possible. In terrestrial forms (grouse, fowls, etc.), where flight is sustained for short intervals only, the arch is narrower and the structure more slender and delicate.

Taking up the Mammalia with a view to ascertaining the relationship existing between the development of the clavicles and the work done by the fore limbs, let us start with the following general proposition as a basis for our observations, namely, that those animals which have the fore limbs specialized over the hind limbs in relation to work, possess a clavicle, and where the hind limbs are the most highly specialized, the clavicles are rudimentary or entirely wanting.

Leaving the ornithodelph mammals (the Australian duck-bill, Echidna, etc.), with their bird-like shoulder girdle, we note the presence of more or less well developed clavicles in all the marsupials, with the single exception of the "bandicoots" (Peramelidæ), where it is wanting, and its absence may be accounted for from the fact that the bandicoots from their terrestrial mode of life, nesting in hollow places and feeding on insects, roots etc., have for a long time had their fore limbs subjected to less complex conditions than the arboreal and predatory families, the opossums (Didelphidæ), the Dasyuridæ, the phalangers (Phalangistidæ) and the kangaroos (Macropodidæ), which constitute the rest of the order. In the kangaroos the clavicles, though pres-

ent, are slender and delicate, the weak fore limbs coming into use in manipulating the "pouch," etc., thus throwing a variety of motion into the shoulder joint, which explains the presence of clavicles in an animal whose locomotion is almost entirely performed by the hind limbs.

Among the Insectivora, a large order of wide geographical range and rather uniform life, the majority of species being terrestrial and fossorial or burrowing, we have the clavicles well developed with but one exception, that of *Potamogale velox*, a rare form from Western Africa, and this is the only insectivore which is almost entirely aquatic. It measures about two feet in length with a long cylindrical body, tapering continuously into a thin, laterally compressed tail, which is the main propulsive power when swimming, the short legs with their unwebbed feet drifting back against the body. Another form, Myogale, from the streams of Southeastern Russia, is natatorial and possesses a clavicle, but the feet are all webbed and come into play along with the tail as organs of propulsion.

The moles, Talpidæ, are eminently fossorial, their excavations being everywhere known; an East Indian squirrel-like form is arboreal; all the rest are terrestrial and fossorial.

The order Edentata is divided into two primary groups, the "leaf-eaters" (Phytophaga) and the "insect-eaters" (Entomophaga). The Phytophaga comprise the "sloths," curious, arboreal forms inhabiting the South American forests, represented by only two living genera; they are entirely arboreal, making characteristic progression among the tree-tops on the leaves of which they feed. In the two-toed sloth, or "unau" (Cholœpus), the clavicles are well developed; in the "ai," or three-toed variety (Bradypus), they are small, rudimentary, having lost their sternal attachments and evidently undergoing a retrogressive change, due probably to some variation in the animal's life and habits which brings the part into less active use.

In the Entomophaga (ant-eaters, armadillos, etc.) we find the clavicles fully developed in the climbing two-toed ant-eater Cyclothurus, a small South American species; also in the Cape ant-eater, or "aard-vark," Orycteropus, a burrowing form from the Cape of Good Hope; while in the great ant-eater, Myrmecophaga, a strictly terrestrial form but not fossorial, the clavicles are absent, the long claws tearing open the ant hills and termites'

mounds, and the narrow, flexible tongue securing the food, stand in place of the burrowing habit, thus bringing the shoulder joint under much less active conditions. In the South American armadillos, which are more omnivorous and are "diggers," the clavicles are developed. The "pangolins," scaly covered animals, mainly terrestrial and rolling themselves in a ball on the approach of danger, have no clavicles.

In the order Rodentia we find all the Sciuromorph group with fully developed clavicles; the squirrels are either arboreal or burrowers; the marmots, Arctomyinæ, are typical burrowers, while the beaver, though eminently aquatic, brings the fore limbs into active use in the construction of its dams and lodges.

The Myomorpha (rats, mice, gophers, etc., typical gnawers and diggers) have well developed clavicles, the gnawing habit bringing the fore limbs and shoulder girdle actively into use to steady the head and neck and the object which is being worked upon.

In the Hystricomorpha (porcupines, cavies, etc.) clavicles are found developed in the climbing tree-porcupines (Sphingurinæ), of which our Canadian species (Erethizon) is a member, and absent in the large African porcupine and all others of the Hystricine group, which is strictly terrestrial but not fossorial.

The chinchillas have well developed clavicles, the horse-tripping burrows of the "Pampas Viscacha" being too well known to the riders of that region. The agoutis (Dasyproctidæ), inhabiting the banks of streams in the South American forests, semi-aquatic and sub-ungulate (*i. e.*, having the feet partially encased in a horny sheath or hoof) have rudimentary clavicles. The Caviidæ (guinea pigs) and the "capybara," the largest living rodent, semi-aquatic, with webbed feet, have imperfect clavicles.

The Lagomorpha consists of two living families, the Lagomyidæ, small burrowing animals called "picas," inhabiting Alpine regions, and the Leporidæ (hares and rabbits); the former family having well developed, the latter rudimentary clavicles. The hares are typical runners, solitary, never burrowing, depending for safety in speed and making their characteristic "form"; the species known as the rabbit, however, differs largely in habits from the other members of the family, being more or less gregarious, living in "warrens" which it burrows out, and having much less capacity for speed. Clavicles are developed in both;

very rudimentary in the hares, and in the rabbits existing as a bone incomplete at the ends, a condition which we would expect to find from the variation in life habits.

Taking up the large order of "hoofed" animals, the Ungulata, we note the complete absence of the clavicles in all the forms, not a vestige of the bony structure being found in any one of them. They are the "runners" *par excellance*, and if we may use the expression, *live on their legs*, the capacity for speed and endurance being one of the chief factors aimed at by natural selection in maintaining and perfecting the species.

Here we find the fore limbs subserving the hind limbs in relation to work; the latter are the main motor power in running, while the fore limbs act chiefly as supporters and guiders; hence the entire absence of clavicles. The marine Mammalia, with their rudimentary limbs, have no clavicles.

In the flesh-eating animals, Carnivora, the clavicles are always rudimentary, and in many cases entirely wanting. They are better developed in the cats, Felidæ, than in any other family of the order (though the articular extremities of the bone are lost), for the clutch which follows the spring in securing their prey, brings the fore limbs into more active use than in the dogs and wolves, Canidæ, which run their quarry to "the death," and then pull it down by force of numbers. Many of the cats, too, frequent trees, but they spring from place to place and do not properly climb. Several species of bears also climb, but the habit is more acquired than natural, the fore limbs clasp the trunk while the hind ones secure a foothold and, so to speak, shove the animal upward, very different from the active movements of a natural climber.[1]

In the bats, Chiroptera, as we would expect from their mode of life, the anterior limbs being the main factors in their flight, clavicles are developed, long, curved and strong.

The arboreal Lemurs also have them developed.

In the order Primates we have the clavicles present in all, from the arboreal monkeys up through the anthropoid apes to man, where the anterior limbs attain such perfection, with ball and

[1] The badger (Taxidea) is a striking exception to the general rule, being an eminently fossorial animal yet devoid of clavicles. The fore feet are armed with exceedingly long, slightly curved claws, probably bringing greater leverage on the wrist and elbow joints and thus partially supplementing the absence of clavicles.

socket shoulder joint capable of such varied and extensive motion, with a high degree of pronation and supination of the fore arm, and last, but not least, the wonderfully specialized hand with its thumb opposable to each of the four digits.

After this brief survey, and with the forementioned proposition in view, viz., the correlation existing between the development of the clavicle and the work done by the fore limbs, we are left to draw the rational conclusion that the subject under consideration is one of *use* and *disuse* of parts, as Darwin has so clearly pointed out in his chapter on rudimentary organs in the Origin of Species. The facts we have noted in our hasty glance at the Mammalia confirm this, in the more or less perfect development of clavicles in arboreal, fossorial, aërial and all other forms where the fore limbs are the active, aggressive pair in the life of the animal, and their absence or rudimentary condition in the hoofed animals, the marine species and all others where the anterior pair take a secondary place in the work done by the limbs.

As there is, of course, no actual disuse of a part as a whole (the nearest approach to this being in marine forms), a simple, uncomplicated motion existing, with little strain at the shoulder joint, the parts require less support and fewer points for ligamentous and muscular attachment than where the movements are more complicated and the strain more severe. Consequently we have a greater or less differentiation in the elements of the shoulder girdle as the case may be, and the clavicle, holding as it does a position of secondary importance, is the unstable, variable element.

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PEAR BLIGHT AND ITS CAUSE.

BY J. C. ARTHUR.

PEAR trees in this country are subject to an endemic disease that, owing to its malignancy and frequent occurrence, is well known to cultivators and fairly well discriminated by them. It is known both as *pear blight* and *fire blight*, and the same disease in the apple and quince is also called *twig blight*. The term blight is applied to many kinds of plant diseases, and especially to those that eventually kill without rendering the cause conspicuous; it is also the name of a class of disease-producing fungi. The pear malady bearing this name is, however, a specific disease, although

it would be a matter of considerable difficulty to describe it in such diagnostic terms that the reader would recognize it under all conditions and avoid confounding it with the numerous other blights and incidental maladies which resemble it. Its most characteristic feature, if one considers only pomaceous trees, such as the pear, apple, quince, crab, hawthorn, etc., is the complete dying of the branches subsequent to the appearance of the foliage without obvious cause and usually with apparent suddenness. This involves the limb and its leaves, both of which turn blackish and usually exhale a peculiar but not very strong odor. From the softer stems there often exudes a viscid, whitish substance forming small drops on the surface of the bark and finally becoming hard like an exudation of gum.

The blackening of the dying branches does not differ from that produced by death from other causes; hence arises the danger of mistaking other injuries of the tree for the true blight as here understood. Death may be brought about by the limb being partly broken off, or it may be punctured and killed by the pear-blight beetle (*Xyleborus pyri*), a very small insect which often escapes detection, or it may result from other mechanical injuries. There is also the blackening of the ends of young twigs in spring known as frozen-sap blight, the blackening of the edges of the leaves later in the season, more common on some varieties, *e. g.*, the Sheldon, than on others, and so on. But the real blight kills the limb in advance of the leaves, and will usually show the blackened bark, when raised with a knife, below the lowest dead leaves; the gummy exudation, when that is to be found, is abundant confirmation. In addition to this, the extent of the malady, sometimes embracing the larger part of the tree and most of the trees of the orchard, assures one of its identity. Pear leaves may at times assume a deeply bronzed appearance and the bark become dark colored, but these appearances need never be mistaken for blight, as the tissues beneath will be found normally green and healthy.

The disease is most observed during July and August. It may manifest itself upon any part of the tree, but starts rather more often at the ends of the main branches, and will first attract attention by the dead leaves. All above the affected parts will usually die, and if the branch is not removed the disease will gradually extend toward the trunk of the tree. It is purely a local disease,

and affects no part of the tree but the branches attacked. Sometimes a whole tree is killed, but usually only certain limbs die, which if early removed will leave the remainder of the tree in normal condition. The progress of the disease along the limb is variable, but in general is greatest during the hottest weather; in winter it moves slowly, even advancing but six to twelve inches during a whole cold season. The advent of spring, quite contrary to what one would expect, usually checks the disease after it has defied the rigors of winter, and by the time the tree is well clothed with leaves is brought to an end, not to be again revived.

So extensive and prominent a disease of an important fruit tree, and one entailing heavy pecuniary losses during epidemic years, has naturally been the occasion of much discussion. Its cause being obscure and the manner of its incursions and spread mysterious, it was variously ascribed to the soil, the weather, the electrical influences of thunder storms, to undiscovered fungi, and many other agents. These attempts at explanation were all unsatisfactory, failing to account for many of the phenomena connected with the disease.

The first substantial advance toward a solution of the question was made by Dr. T. J. Burrill in his memorable announcement in 1880 to the American Association for the Advancement of Science that he had discovered bacteria in invariable connection with the disease. The same discovery was reiterated by the author in an article in this magazine for July, 1881. He also proved that the disease is infectious and may be communicated to healthy limbs by inoculation, using the gummy exudation as a virus either with or without dilution with water, and not only to pears but to apples and quinces as well.

No additional discoveries of note were made till the investigation, which is still continued, was taken up by the writer in July, 1884. The subject need not be further treated chronologically, as a clearer and more concise statement can be made by giving the present condition of our knowledge irrespective of the order of its acquisition.

The term bacteria is a generic one, and covers many forms exhibiting great morphological and physiological differences. The form causing pear blight does not belong to the genus Bacterium, as one might infer, but to the genus Micrococcus, and bears the

full name of *M. amyliovorus* Burrill. Members of this genus are globular, or somewhat longer than broad, either single or in short chains of a few individuals; they multiply by a transverse division, each half growing to the size of the original from which it was derived, and finally becoming an independent cell. The formation of spores does not occur, or at least has not been discovered, in this genus; no transformation takes place.

The pear blight Micrococcus is oval in outline and measures 1 by 1 ½μ, which is .00004 by .00006 inch. This is extremely small, so small, in fact, that it would take more than a thousand placed end to end to reach around the period at the close of this line. They are considerably smaller than the bacteria of common putrefaction (*Bacterium termo*), the hay bacteria (*Bacillus subtilis*) which usually appear in all sorts of vegetable infusions, and many others. On the other hand they are by no means so small as the germs of diphtheria (*Streptococcus aiphtheriticus*), of smallpox (*S. vaccinæ*), and others. When in active growth they are single or attached to each other in pairs, dumb-bell form; when growing more slowly there is a larger proportion of the dumb-bells, and in addition chains of four to six cells each.

Although these bacteria are very small, yet there is no difficulty in demonstrating them in the tissues of the pear tree on account of their extraordinary abundance. The slightest fragment taken in midsummer from a blighted pear limb and placed in a drop of water will readily enough show the presence of bacteria to the unaided eye by the white cloud of them which spreads from the bit of wood throughout the water. Slice up some blighted wood into a small quantity of water and it will be rendered milky by the enormous outpouring of the bacteria. Under the microscope these are found to be all of one kind, and not intermixed with ordinary putrefactive or other bacteria, a circumstance which may yet be turned to account in studying problems in which an admixture of forms is detrimental. The exudation already referred to is found by the microscope to be composed solely of blight bacteria and a soluble substance which holds them together.

When in very vigorous growth the blight bacteria are active, and present an animated appearance under the microscope, but usually they have only the molecular movement common to all small particles suspended in fluid. Their progress through the

plant is doubtless largely due to simple displacement as multiplication takes place, although aided by the limited activity of the organism and the movement of the sap.

The change induced in the tissues of the tree partakes of the nature of a true fermentation. That we do not have to do with a putrefactive change is patent enough, as no offensive odor is given off. The disengagement of carbon dioxide may be made evident by partially filling a test tube with fragments of a freshly blighted limb and adding water enough to little more than cover them. In a short time bubbles of gas will be set free, and a drop of lime water held in the tube will show the presence of carbon dioxide by the whitening of its surface. It is not so easy to determine the nature of the other products formed. Careful and repeated tests give no indication of the occurrence of butyric acid. The presence of alcohol in very slight amount was shown by means of the delicate iodoform test. For this a nearly full-grown Bartlett pear, which was thoroughly permeated with the blight bacteria from an inoculation made a week before, but the tissues still undiscolored, was distilled and the distillate used for the test. The amount of alcohol found was so slight, however, requiring a microscope to find the crystals produced by the test, that it did not account for the main bulk of the product of the organism's activity. This product is presumed to be mainly gum of some sort, for the following reasons, *inter alia:* the solubility, adhesiveness, taste or rather tastelessness and the appearance upon drying. There is much probability, indeed, that this belongs to the viscid fermentations, which have been but little investigated.

The bacteria in the tree first attack the starch of the cells, then the cellulose of the cell walls, and finally the whole tissue becomes a liquid mass. When, however, the cell walls consist of lignin or other secondary substances they are not broken down. The action on the cell wall is best seen in the tender, unmodified tissues of the fruit.

After this survey of the characteristics of the organism and the chemical changes which it induces, it will be profitable to learn something of the nature of the disease itself. The usual impression has been that the disease is like a blast of superheated air passing over an orchard, leaving dead and blackened foliage in its track, or that it appears suddenly as the result of a thunder

storm following hot and damp weather. Its true nature, so different from these conceptions, has been learned by inoculating healthy limbs with germs from an affected tree and closely watching the progress of the disease through its whole course from inception to the death of the limb. The inoculation is made by puncturing the limb and applying some of the gummy exudation, or, better, a drop from a watery solution of it, or from water in which some diseased tissue has been sliced. If this be done in July and the inoculation be made in a young and tender shoot, the tissues near the wound will show discoloration in about a week, and in the course of a week longer the leaves and end of the shoot become blackened and dead. Let it be noticed that at the most favorable season for development it requires some two weeks from the time of the áttack to enable the disease to gather sufficient headway to be conspicuous; for no observer is likely to detect the change in the color of the bark before the dying leaves have fixed his attention, unless he knows an artificial inoculation has been performed. This sufficiently disposes of the supposition that the disease is sudden in its action; still more marked proof will be adduced later, showing that in natural course it is slower yet. Over two hundred recorded inoculations have been made, and from these we learn that the disease makes the most rapid progress in the newest and most succulent tissues; and the nearer to a vigorously growing bud an inoculation is made, the more likely it is to succeed. In fact, it was soon found that no result was likely to follow an inoculation in wood a year or more old. This suggested the inoculation of growing fruit; the results were most surprising, for the tender parenchymatous tissues were entirely broken down into a creamy fluid, which now and then escaped at the wound made in inoculating and dripped upon the ground.

Repeated attempts to convey the disease by inoculating the leaves resulted in failure, except a partial success when very young leaves were tried. It is noticeable that the leaves are the last to succumb to the disease; they will remain green for days or even weeks after the bark at that point has become brown and dead. Bacteria cannot be found swarming in the leaves as in the bark and wood; the conditions do not seem favorable for their development. The conclusion is inevitable that the death of the leaves on a diseased branch is chiefly due to the cutting off of the supply of sap.

The investigations of Professor Burrill showed that the disease might be conveyed to the apple and quince trees also. Not only was this easily confirmed, but inoculations were successfully performed on the English hawthorn (*Cratægus oxyacantha*), the evergreen thorn (*C. pyracantha*), and the service berry (*Amelanchier canadensis*), while they failed on grape, raspberry, mulberry, peach, etc.; that is, they succeeded on members of the pear family, but not on other plants. The virus was from the pear, apple and quince, interchangeably, and showing no perceptible difference in the results that could be traced to the kind of virus used. The only differences to be noted were such as were obviously accounted for by the varying ripeness and solidity of the tissues. Unsuccessful inoculation was made upon the mountain ash (*Pyrus aucuparia*), but as the tissues were already solid when done, and as branches suffering with the disease have since been found, there is no doubt that it can be communicated if the inoculation be properly performed.

In the studies so far detailed the germs were artificially introduced into the branch; the problem of how they gain entrance naturally seemed for a time well nigh unsolvable. Virus smeared upon the outside of the branch, leaf or fruit had no effect; diseased branches tied among healthy ones under the most favorable circumstances for contagion gave no results; apparatus arranged to draw air across diseased branches upon healthy ones also failed; copiously watering a potted pear tree for a month with water white with blight bacteria had no deleterious action on the tree; and yet the germs must gain entrance some way, for it is inconceivable that they should originate spontaneously within the tree. Finally some light was secured by a series of partially successful experiments in which water containing blight bacteria was arranged to drip upon pear and apple twigs; the germs entered the twigs through the moist surface of the youngest tissues. A fortuitous observation now made the matter clear; it was noticed toward the end of June that the English hawthorns, which blossom very freely about the middle of May, were seriously affected with blight. At the time of observation the flowers had long since disappeared and the fruit was well advanced toward maturity. The blighted branches, however, were still crowned with dead flowers, and wherever the dead spur or branch was not terminated with a truss of flowers it showed

every evidence of having been arrested in the midst of rapid growth. The conviction was established that the germs enter the tree in spring through the moist glandular surfaces within the flower or the tender surfaces of expanding buds, but that the disease does not make sufficient progress to become conspicuous till the warm days of June or July. As the flowers drop and the branches cease extending less and less chance exists for the tree to take the disease. Insects may now and then transfer the germs, for two pears were found the present season filled with blight, in both cases showing the point of entrance, evidently a puncture made by an insect. It is only in some such exceptional way that the germs can gain admittance through the well protected surface of fruit.

If the germs pass from the air into the tree, in what manner do they get out into the air again at the proper time for the next season's attack? Manifestly the bacteria within the tree are securely imprisoned by the bark, which as effectually prevents their escape as it does their entrance; and at any rate, in spring, the time for attack, there are few bacteria left alive in the tree. Limbs with tender tissues exude great numbers of germs during July and August, but so agglutinated that the air cannot dislodge them, until the rains have washed them to the ground and dissolved the gum which binds them together. The query now presents itself whether the germs may not be able to thrive outside the tree. To test this, cultures were tried in various media, and it was found that infusions of hay, corn meal, starch and various other vegetable substances make a nutritive fluid in which the blight bacteria flourished in varying degrees, no matter whether the solutions were acid, alkaline or neutral. When transferred from the culture fluid to the tissues of the tree, the usual form of blight follows. This plainly indicates that the germs washed from the tree by rain may find congenial nidus among vegetable refuse, thrive and multiply, pass the winter, for cold does not injure them, even pass an unfavorable year or two, and at times being swept into the air be brought by gentle rains or an arresting film of dew into contact with the delicate surfaces of expanding shoot or flower and infection be secured.

Now having shown the progress of the disease to be coördinated with the development of germs and traced the life cycle of the germs, there may still be persons who do not believe that

germs cause the disease, but that they are merely accompaniments of it. To meet this objection, and place the subject upon a logical and irrefragible basis it is necessary to state the results of still further studies. In order to determine whether other bacteria will grow under the same circumstances, various kinds were inoculated into pear trees—bacteria from rotting spots in green tomatoes, from various sorts of putrefactions, those which had incidentally appeared in various culture experiments—and uniformly with negative results. When inoculation was made from a culture of blight bacteria contaminated with other forms, the resulting blight contained but the one sort. It is a well-known fact that most bacteria will not thrive in acid solutions, and Hartig has supposed that the reason that plants are so free from parasitic bacteria (only two, or at the most three, true vegetable parasites being known among them) is that they cannot withstand the acidity of the sap. Be this as it may, only one form of bacteria has yet been found to accompany pear blight.

But this does not dispose of the possibility that the blight is not caused by the bacteria, but by some deleterious substance which goes with them or which they produce. It is obvious that as the blight may be produced by using a drop of water which has been flowed over blighted tissues, the active agent must be either the bacteria or the substances which the water dissolves. There is a very simple way of separating solutions from bacteria by filtering through porous earthenware, which permits the fluid to pass, but not the bacteria. It has been demonstrated by trial that inoculating from a filtrate prepared in this way will not produce the blight. Separating the bacteria from all accompanying substances is accomplished by means of fractional cultures. Such a drop as used for inoculating is introduced into a suitable sterilized culture fluid; after some days, when the bacteria have well filled it, a drop is removed and used to start another culture, and so on. In this way the bacteria are kept vigorous by growth and multiplication, and the unvitalized substances which accompanied them in the first drop are more and more diluted at each transfer. Finally a drop from the last culture of the series, in which the amount of substance derived from the original drop must be so infinitesimally small as to be inoperative, is used to inoculate with again. Carefully conducted experiments of this kind have given as severe blight as in direct inoculation. No stronger proof is needed that the bacteria are solely responsible for the disease.

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— There is little difference of opinion among the scientific men of this country as to the great value of Government aid to scientific research. Not only is its importance obvious to them as craftsmen, but as citizens. It is not worth while to make nice theoretical distinctions between State and United States rights in this matter, for the great point is to secure, in the language of Smithson of illustrious memory, "the increase and diffusion of knowledge among men," and especially the men of this country. If the State governments are too indifferent to their own interests to foster the work, let the General Government sustain it. Its utility is two-fold. The one object which is alway obvious, is the exploration and exposition of the resources of the country. The other, no less important, but less understood, is the development and occupation of the intellectual force, activity and thought of the men of the country. The cultivation of man is the most important of human enterprises, and a republican form of government rests on a basis of such cultivation. The government aid to the universities of Germany is one of the principal assurances of progressive, or even continued, civilization which the world possesses. As the Government of the United States does not aid the universities of the country, it should not fail to sustain and develop its own system, which embraces the various scientific bureaus at Washington.

It has sometimes been objected that the great power of the Government treasury constitutes it such a rival, as to seriously discourage private enterprise in this direction. There are two reasons why this reasoning is fallacious. First, the field of science is so vast that no organization can cover it; there is always room for workers, especially at the top. Second, brains are not produced by money, and ideas are not for sale on demand. The thinker who produces ideas on $1500 a year, will only be too glad to have some one in Government employ to illustrate them with larger resources. Moreover there are some departments of scientific work in which the Government can have few or no rivals. These are the expensive enterprises which private persons can rarely sustain. Such are deep-sea explorations; harmonious geodetic surveys over wide areas; geological surveys in regions which are for some reason inaccessible or dangerous;

also excavations for fossils on any but a limited scale. The creation and support of scientific museums and laboratories must have the assistance of a heavy purse; and finally, governments have generally been the only medium of publication of results on any considerable scale.

Official science has, however, no shield of Achilles which shall protect her from the usual temptations of power and from the methods of politics. It is true that she more surely stands or falls on her merits than any other representative of human labor, yet as she is the teacher of mankind, who is to decide the question of merit? That she may become corrupted, so that the love of fame and power may supplant the love of knowledge, is not impossible. The man of politics can see and understand this, and whether true or not, charges against scientific men holding official position will be preferred, as in the case of other office-holders. The public press has on various recent occasions applied the term "political scientist," and has attempted to point out persons to whom the expression is appropriate. Although a "political scientist" is a conceivable person, the applications made by the newspapers have been wide of the mark. The term is not appropriate to a man because he secures large or small appropriations from Congress to be expended on scientific work. All honor to such men, whoever they are. Their country and the world owe them gratitude, not sneers.

If we were to seek to define a "political scientist" we would describe him as a man who sought the aid of the resources of the Government to hold an office for its emoluments or honors to which his abilities and services to science do not entitle him. In order to do this he will reproduce the ideas of others without acknowledgment; he will endeavor, through means well known to men in official position, to suppress criticism of his work, and thus to reach an eminence of popular reputation which is purely factitious. Such would be a man who might appear to fulfill the duties of his position by the employment of persons to do his scientific work for him. A "political scientist" would spend little time in his study, and a great deal of time with prominent persons of all kinds, gaining the "influence" that comes from personal representations in the many quarters where the merits of questions of science are unknown. The "political scientist" might flourish for a time in this country, and his existence would be a constant menace to the prosperity of Government scientific enterprises, and would react disastrously on the men of real merit.

—— The Legislature of Michigan has done itself discredit in the treatment of the last Geological Survey of that State. It removed Professor Rominger, a most competent man, and put in his place a man less known, who, however, has his future in his own hands. It refuses to publish the report of Professor Rominger,

although the money for this purpose is in the hands of the State treasurer. This money was saved from his meager appropriation by Professor Rominger, who thus offers to the Legislature a rare example of economy. The governing body of Michigan should recognize this fact by returning the money to their ex-State-geologist, and publishing the report without delay by a new appropriation. Professor Rominger has the endorsement of the geologists of the country.

——:o:——

RECENT LITERATURE.

ROMANES' RESEARCHES ON THE NERVOUS SYSTEMS OF JELLY AND STAR-FISH.[1]—The beautiful researches and discovery by Haeckel of a nervous system in Geryonia, consisting of true ganglion cells and true nerve-fibers, and the extension by the Hertwig brothers of our knowledge of the nervous system of Medusæ in general, especially the naked-eyed forms, marked a most important step in animal morphology.

These microscopical observations were, except Haeckel's discovery, forestalled by the physiological experiments of Professor Eimer and Dr. Romanes, who, however, worked independently of each other. In the present work Dr. Romanes gives a popular account of his own researches, with due mention of and credit to Dr. Eimer's researches in the same direction.

After having some account of the structure of the Medusæ, we are afforded the results of fundamental experiments. The author proved that excision of the extreme margin of a nectocalyx (or umbrella) of the naked-eyed Medusæ causes immediate, total and permanent paralysis of the entire organ. This result is striking and decided. Indeed, adds the author, "I do not know of any case in the animal kingdom where the removal of a center of spontaneity causes so sudden and so complete a paralysis of the muscular system, there being no subsequent movements or twitchings of a reflex kind to disturb the absolute quiescence of the mutilated organism. The experiment is particularly beautiful if performed on Sarsia; for the members of this genus being remarkably active, the death-like stillness which results from the loss of so minute a portion of their substance is rendered by contrast the more surprising." On the other hand the severed margin "continues its rhythmical contractions with a vigor and a pertinacity not in the least impaired by its severance from the main organism, so that the contrast between the perfectly motionless swimming-bell and the active contractions of the thread-like portion which has just been removed from its margin is as striking a contrast as it is possible to conceive." But though in the

[1] *The International Scientific Series.* Jelly-fish, Star-fish and Sea-urchins. Being a research on primitive nervous systems. By GEORGE J. ROMANES, LL.D., F.R.S. New York, D. Appleton & Co., 1885. 12mo, pp. 323.

vast majority of cases it was found that excision of the margin impairs or destroys the spontaneity of the animal for a time, the paralysis so produced was very seldom permanent. After a variable period occasional contractions are usually given, and in some cases they were resumed with but little apparent detriment.

Light was found a most marked and unfailing stimulus, and light *per se*, rather than a sudden transition from darkness to light. Hence it was satisfactorily proved that the "eyes" of these animals are really such, as the following experiment with others, proves:

"Having put two or three hundred Sarsiæ into a large bell jar, I completely shut out the daylight from the room in which the

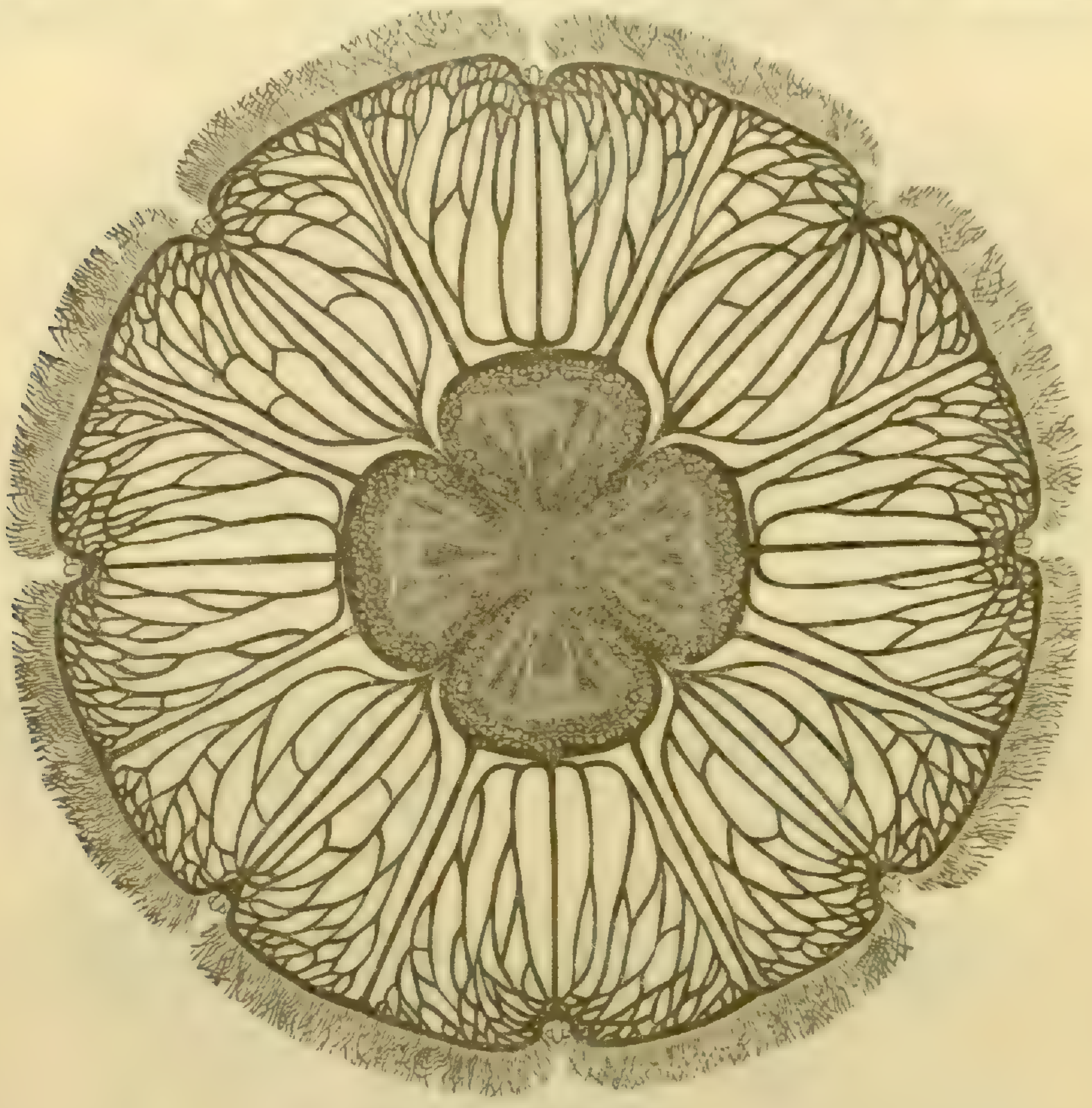

FIG. 1.—Aurelia aurita.

jar was placed. By means of a dark lantern and a concentrating lens, I then cast a beam of light through the water in which the Sarsiæ were swimming. The effect upon the latter was most decided. From all parts of the bell-jar they crowded into the path of the beam, and were most numerous at that side of the jar which was nearest to the light. Indeed, close against the glass they formed an almost solid mass, which followed the light wherever it was moved. The individuals composing this mass dashed themselves against the glass nearest the light with a vigor and determination closely resembling the behavior of moths

under similar circumstances. There can thus be no doubt about Sarsia possessing a visual sense."

Dr. Romanes then describes his experiments on the covered-eyed Medusæ to ascertain the amount of section which their neuro-muscular tissues will endure without suffering loss of their physiological continuity. In *Aurelia aurita* (Fig. 1) the nervous system is compared to a disk of muslin, the fibers and mesh of which are finer than those of the finest and closest cobweb, and if we imagine the mesh of these fibers to start from these marginal ganglia, we shall gain "a tolerably correct idea of the lowest nervous system in the animal kingdom." Now if seven of these eight ganglia are cut out, and the disk mutilated as in Fig. 2, yet the contraction waves, starting from the single ganglion

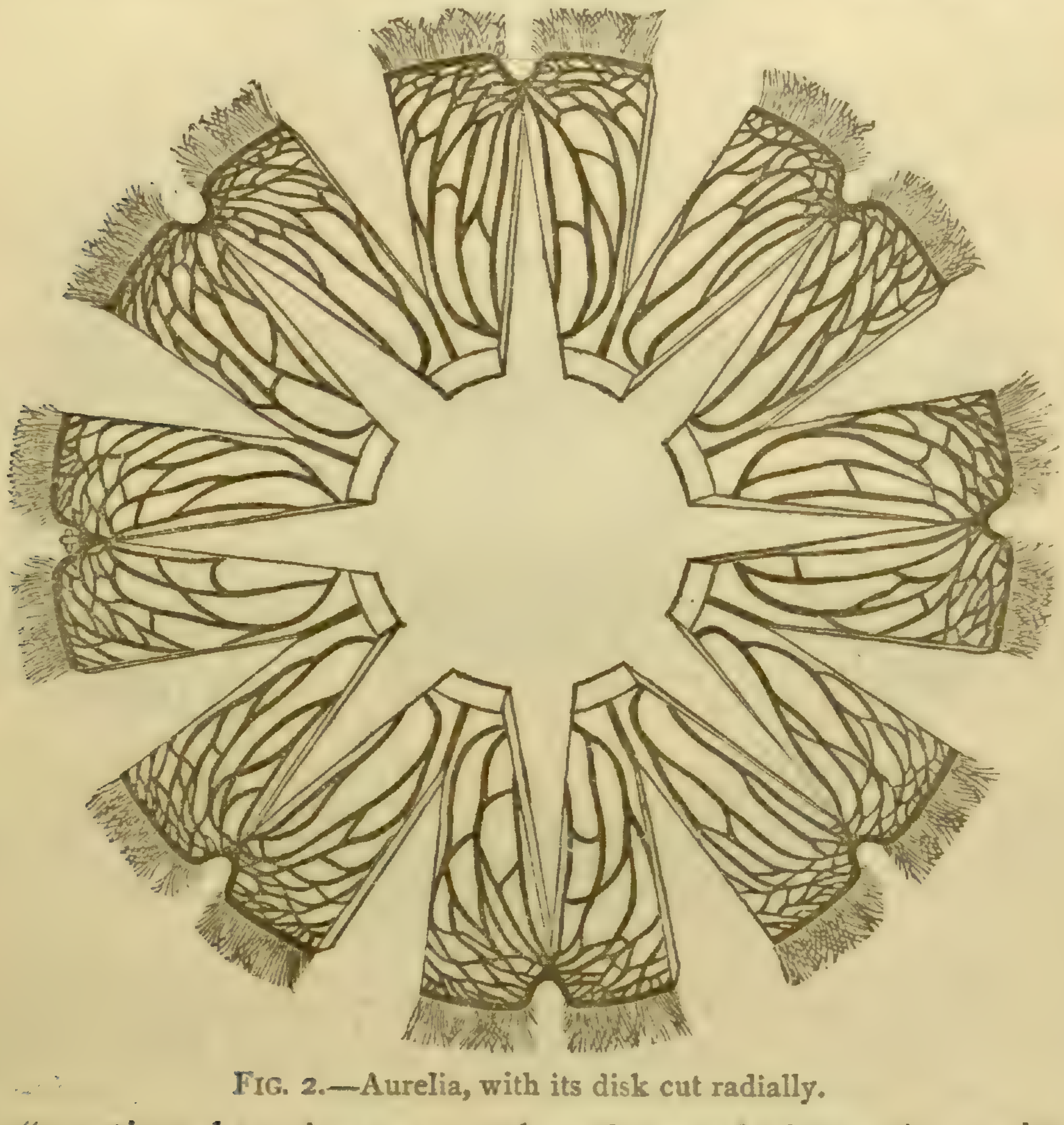

FIG. 2.—Aurelia, with its disk cut radially.

left, "continued to zigzag round and round the entire series of sections."

In a second mode of section (Fig. 3) the central space, *x*, was excised, the circular cut, z, made, leaving the isthmus, *z*, and all the eyes, or lithocysts, were removed except the one at *l*, yet the contraction waves, emanating from *l*, passed in the direction represented by the arrows without undergoing any appreciable loss of vigor. Upon completing the circular cut at *z*, the ring of

tissue (*ys*) became totally paralyzed, while the outer circle, of course, continued its contractions as before.

Lastly a third mode of section was made (Fig. 4); a long strip removed, with the eye and its ganglion at one end and the rest of the swimming-bell at the other, the latter contracting, and such a strip may be made a yard long, but still the portion of the swimming-bell continues to contract. From these experiments and the histological studies of Professor Shäfer, it is seen that the "nerve fibers which so thickly overspread the muscular sheet of Aurelia do not constitute a true plexus, but that each fiber is

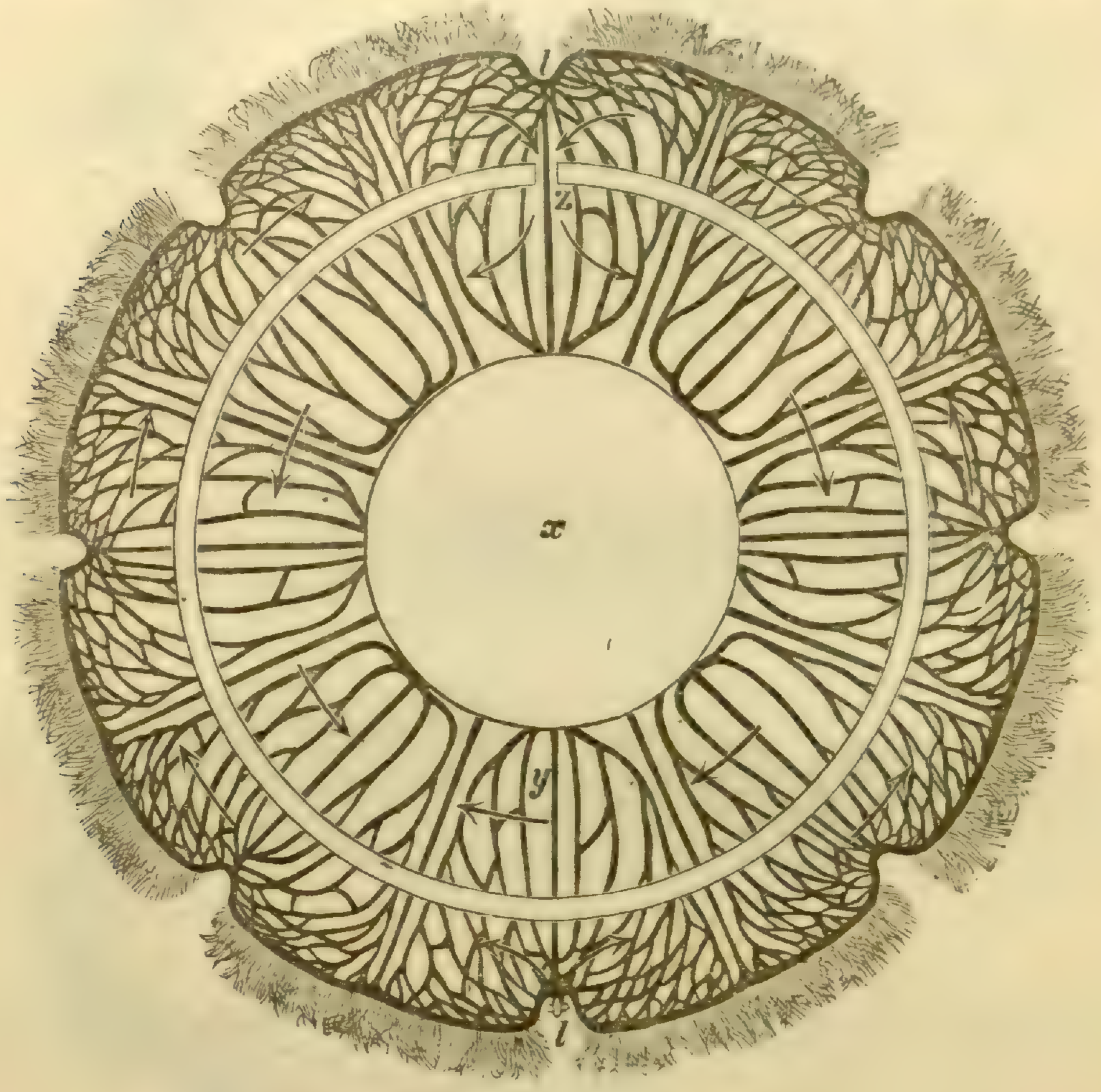

FIG. 3.—Aurelia with a circular cut *z*.

comparatively short and nowhere joins with any of the other fibers; that is to say, although the constituent fibers of the network cross and recross one another in all directions—sometimes, indeed, twisting round one another like the strands of a rope—they can never be actually seen to join, but remain anatomically insulated throughout their length. So that the simile by which I have represented this nervous network—the simile, namely, of a sheet of muslin overspreading the whole of the muscular sheet—is, as a simile, even more accurate than has hitherto appeared; for just as in a piece of muslin the constituent threads, although frequently meeting one another, never actually coalesce, so in the

nervous network of Aurelia, the constituent fibers, although frequently in contact, never actually unite."

Space forbids farther abstracts of the book. The author discusses the regeneration of tissues, the excitable tissues of these animals regenerating themselves after injury with astonishing rapidity. Experiments were made in section of naked-eyed Medusæ; on the coördination of movements, and on the natural and

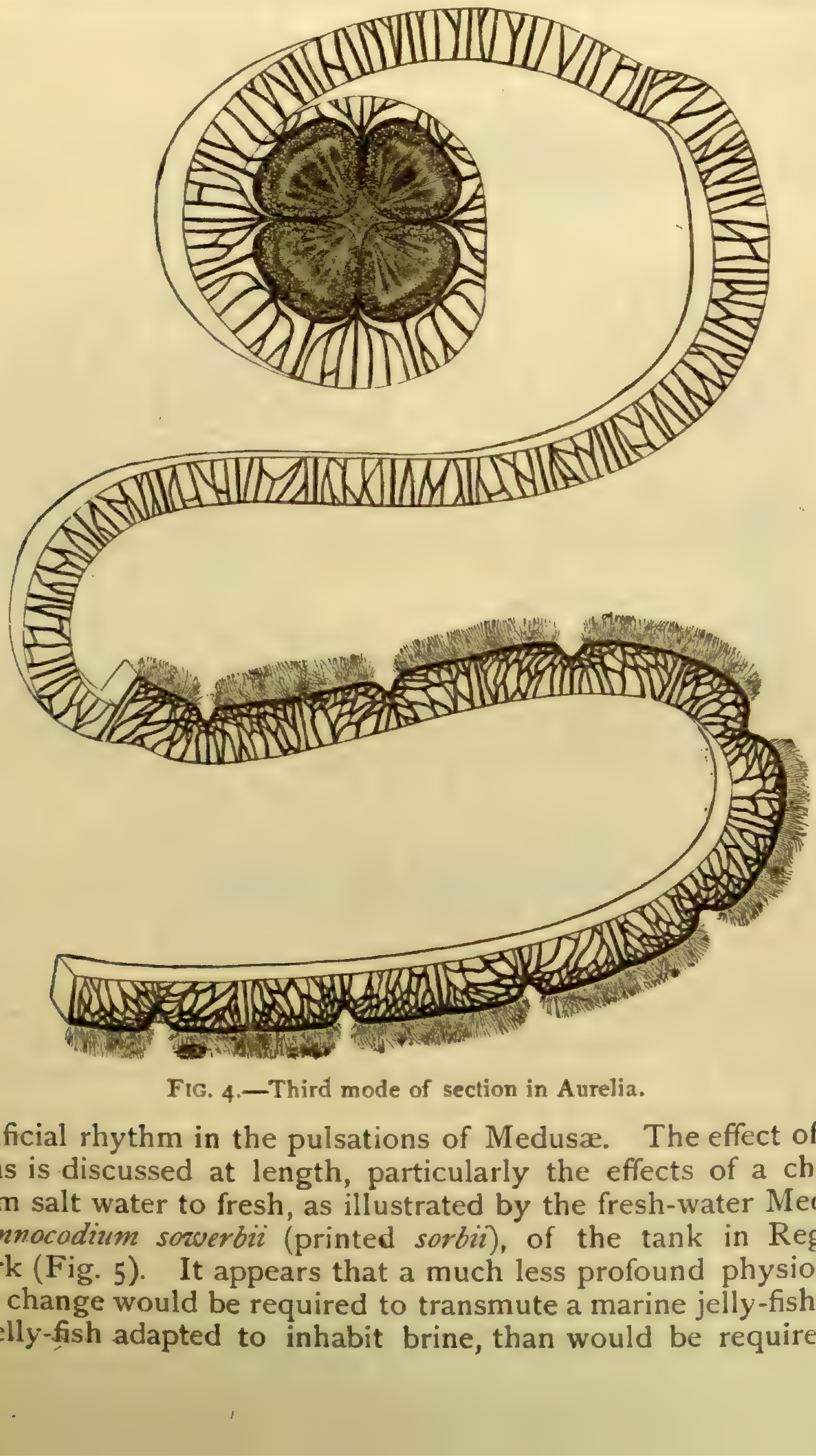

FIG. 4.—Third mode of section in Aurelia.

artificial rhythm in the pulsations of Medusæ. The effect of poisons is discussed at length, particularly the effects of a change from salt water to fresh, as illustrated by the fresh-water Medusa, *Limnocodium sowerbii* (printed *sorbii*), of the tank in Regents Park (Fig. 5). It appears that a much less profound physiological change would be required to transmute a marine jelly-fish into a jelly-fish adapted to inhabit brine, than would be required to

enable it to inhabit fresh water, and it is concluded: "If an animal so exceedingly intolerant of fresh water as is a marine jelly-fish may yet have all its tissues changed so as to adapt them to thrive in fresh water, and even die after an exposure of one minutè to their ancestral element, assuredly we can see no reason why any animal in earth or sea, or anywhere else, may not in time become fitted to change its element."

The book closes with an interesting chapter on the movements

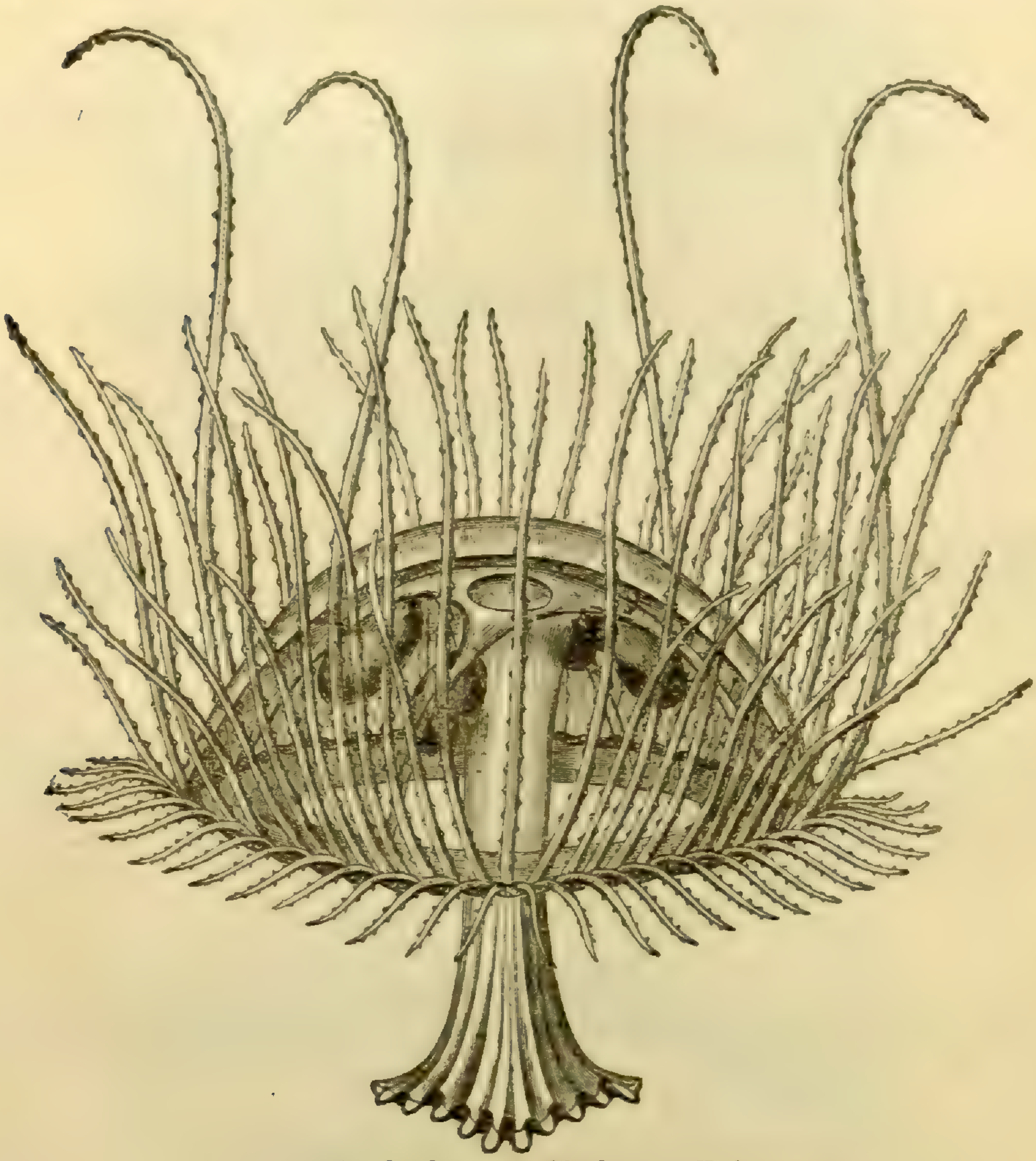

FIG. 5.—The fresh-water Medusa. Enlarged.

of star-fishes. And here it may be said that at the time this portion was written the later discoveries as to the nature of the nervous system of crinoids had not been published. It is now known, by the experiments of Marshall and Jickeli, as well as the histological investigations of the two Carpenters, that the visible nerves in crinoids belong to a general subcutaneous nervous sheet.

The well-known movements of the star-fish are then described and well illustrated (Fig. 6), as well as the natural movements of

a brittle-star when proceeding along a solid horizontal surface (Fig. 7). All echinoderms when placed on their backs can right themselves, but different types have different ways of accomplishing this. The common star-fish does this by means of its

FIG. 6.—Natural movements of a star-fish on reaching the surface of water.

suckers (Fig. 8) in half a minute. The Astropecten rights itself in the way here figured (Fig. 9). It stands on the tips of four of its rays, while the fifth one is thrown upwards and over the others, in order to carry with it the two adjacent rays, "and so eventually to overbalance the system round the fulcrum supplied by the

FIG. 7.—Natural movements of a brittle-star when proceeding along a solid horizontal surface.

tips of the other two rays, and thus bring the animal down upon its ventral surface."

Such movements are more difficult to perform in the sea-urchins, and only fresh and vigorous specimens can right them-

selves at all, owing to the heavy round body and feebler suckers. Fig. 10 represents one on its back with as many feet as possible

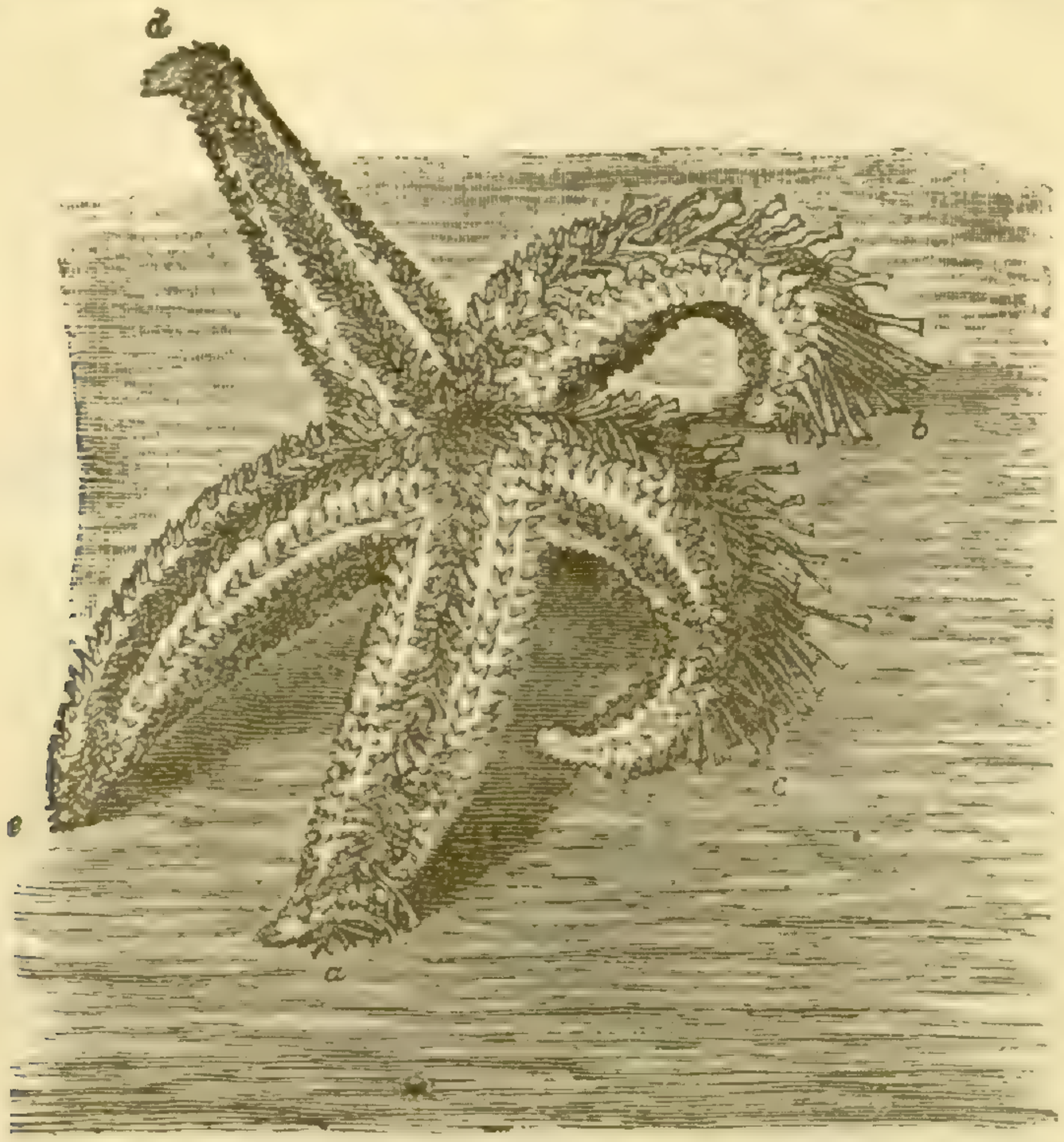

FIG. 8.—Natural righting movements of the common star-fish.

protruded downwards and fastened firmly to the floor, "their combined action then serves to tilt the globe slightly over in their own direction, the anchoring feet on the other or opposite

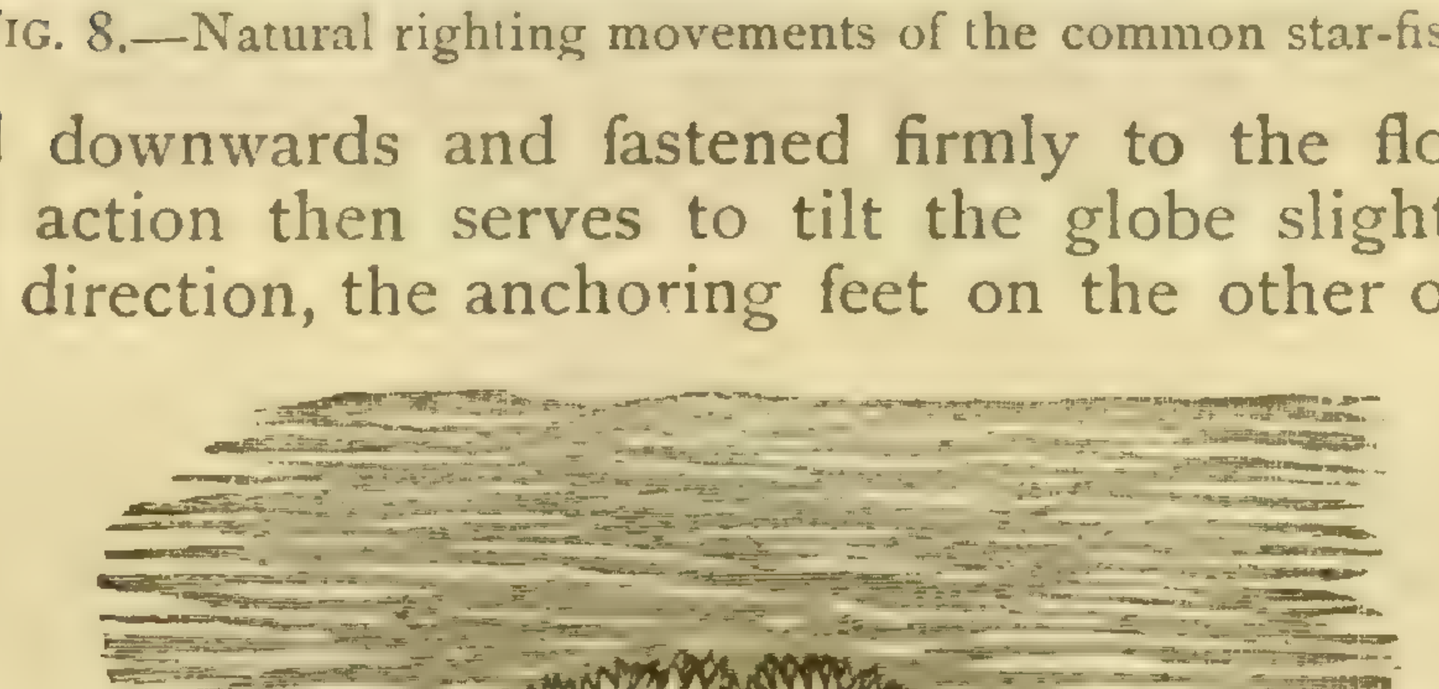

FIG. 9.—Righting movements of Astropecten.

rows meanwhile releasing their hold of the tank to admit of this tilting. The effect of this tilting is to enable the next feet in the

active ambulacral rows to touch the floor of the tank, and when they have established their hold they assist in increasing the tilt; then the next feet in the series lay hold, and so on till the globe slowly but steadily rises upon its equator." Finally it lets itself

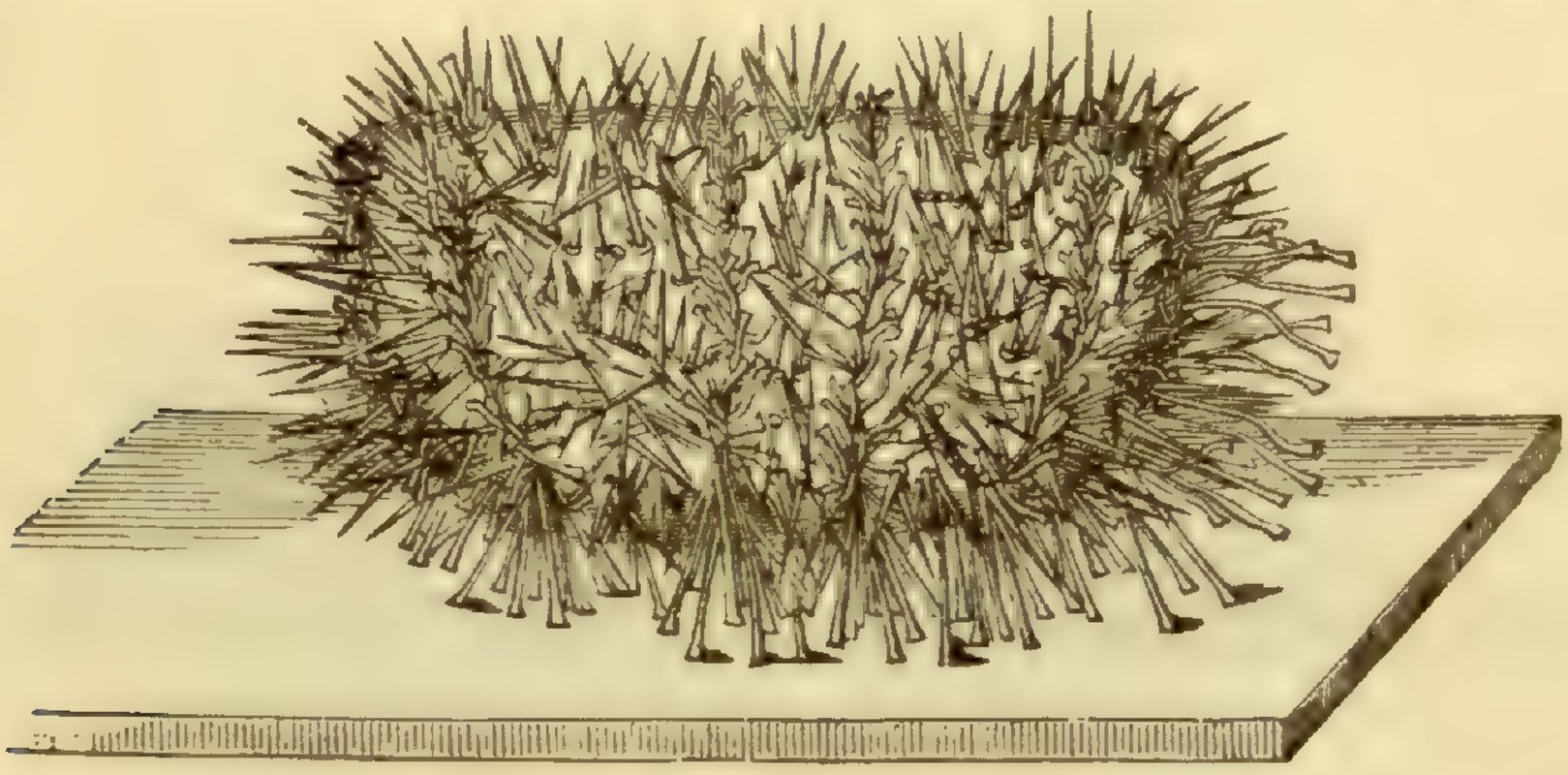

FIG. 10.—Echinus beginning to right itself.

down very slowly and carefully, the feet on one side preventing its too rapid descent (Fig. 11).

Experiments on stimulation were made with the result of proving that the feet, spines and pedicellariæ are all highly coördinated in their action. Taking all the facts of stimulation together, it seemed probable that all these organs are "held in communication with one another by means of an external nervous plexus." Accordingly the author and Professor Ewarts went to work to see if they could obtain any microscopical evi-

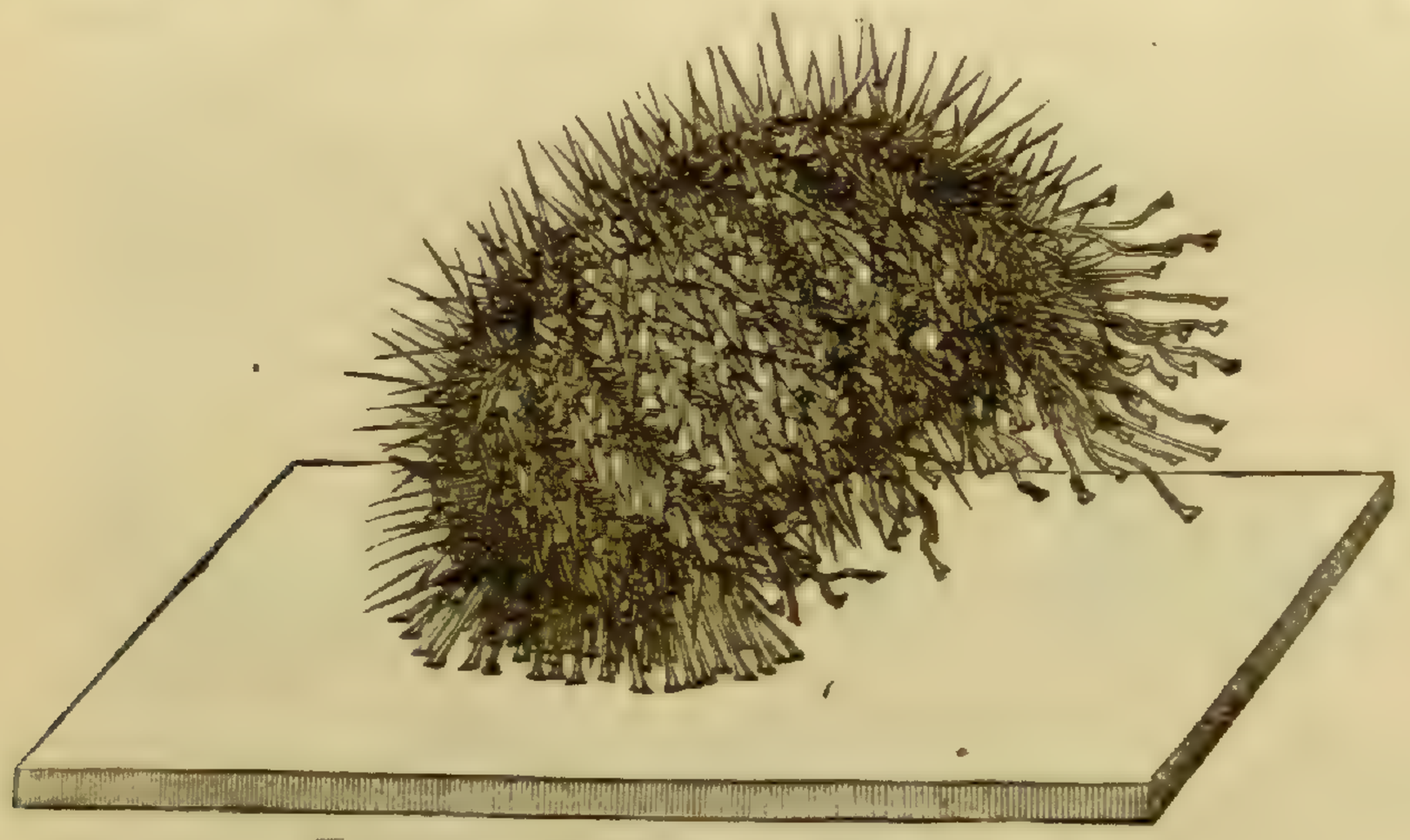

FIG. 11.—Echinus nearly righted.

dence of such a plexus. This they succeeded in doing, and afterwards found that Professor Lòven had already briefly mentioned such a plexus as having been observed by him. The plexus consists of cells and fibers closely distributed all over the surface of the shell, immediately under the epidermal layer of cells (Figs. 12, 13), and it sends fibers all the way up the feet, spines and pedicellariæ. This important discovery led to further experiments on sections. It appears that single rays, when cut off from the body, crawl as fast and in as determinate a direc-

tion as do the entire animals. They also crawl up perpendicular surfaces, and sometimes away from injuries, though not generally seeking to escape the latter as do the entire animals. By severing the nerves at the base of each of the five rays, or by dividing the nerve-ring between all the rays, the animal loses all power of coördination among its rays (Figs. 14, 15). If a continuous circular section of the external surface of the sea-urchin was made, it was invariably found that the spines and pedicellariæ within

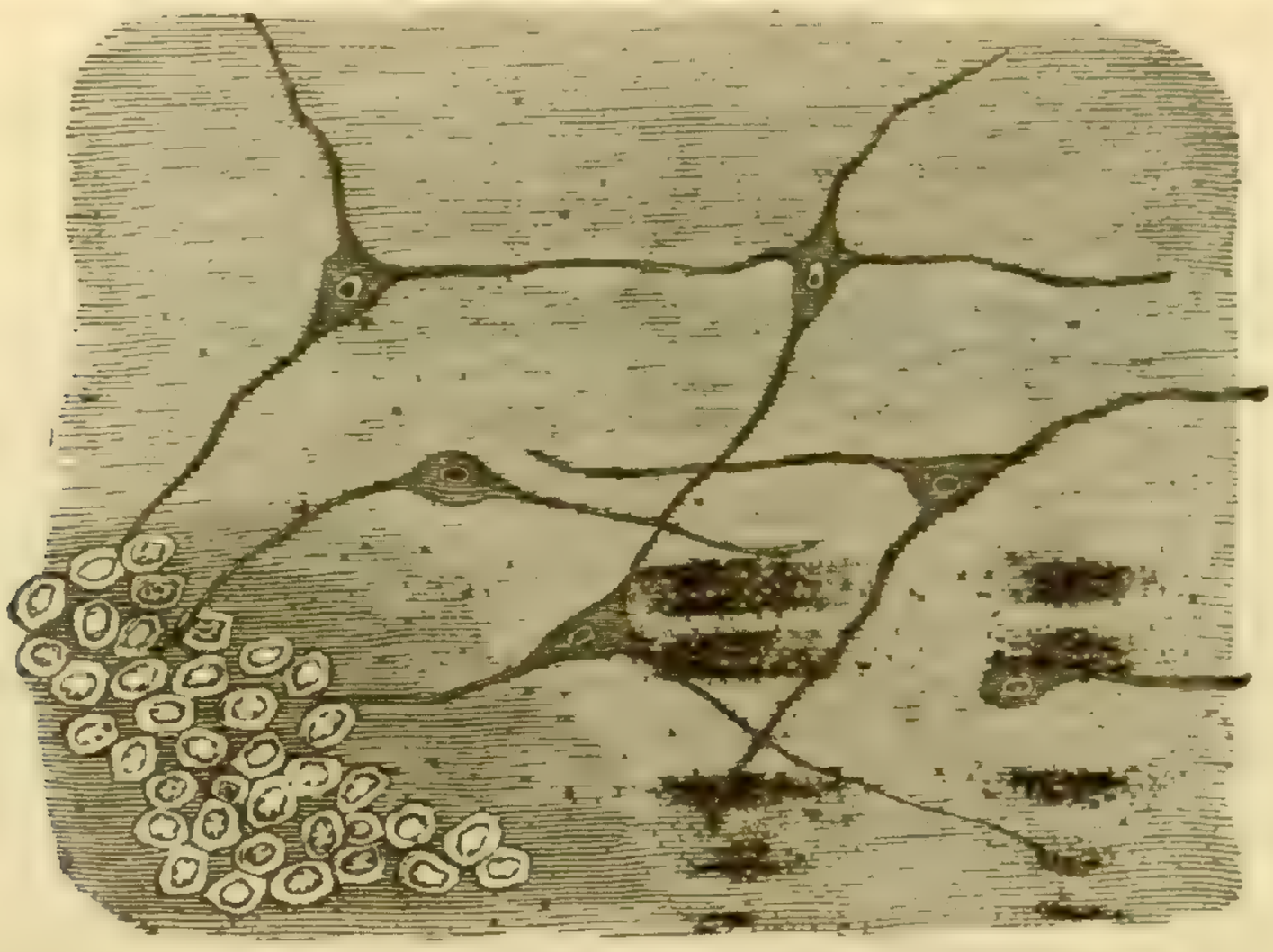

FIG. 12.—External nerve-plexus of Echinus.

the circular area immediately respond to stimulation, while none outside the circle are affected. "These facts prove that the function which is manifested by these appendages of localizing and gathering round a seat of stimulation, is exclusively dependent upon the external nerve-plexus." From these and other experiments, and the histological studies of Professor Ewarts, it is concluded that the nervous system of an Echinus consists (1) of an

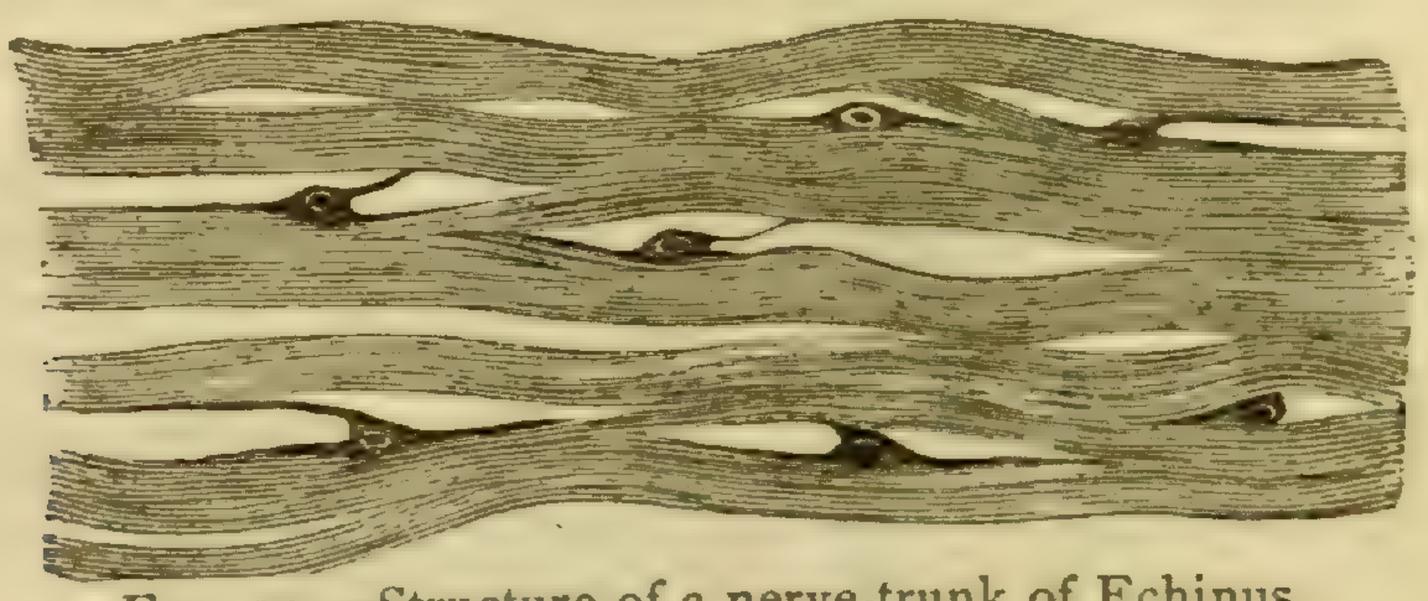

FIG. 13.—Structure of a nerve-trunk of Echinus.

external plexus which serves to unite all the feet, spines and pedicellariæ together, so that they all approximate a point of irritation situated anywhere in that plexus; (2) of an internal nervous plexus which is everywhere in communication through the thickness of the shell with the external, and the function of which is that of bringing the feet, spines and probably also the pedicellariæ into relation with the great coördinating nerve-center situated round the mouth; (3) of central nervous matter which is

mainly gathered round the mouth, and there presides exclusively over the coördinated action of the spines, and in large part also over the coördinated action of the feet, but which is further in part distributed along the courses of the main nerve-trunks, and

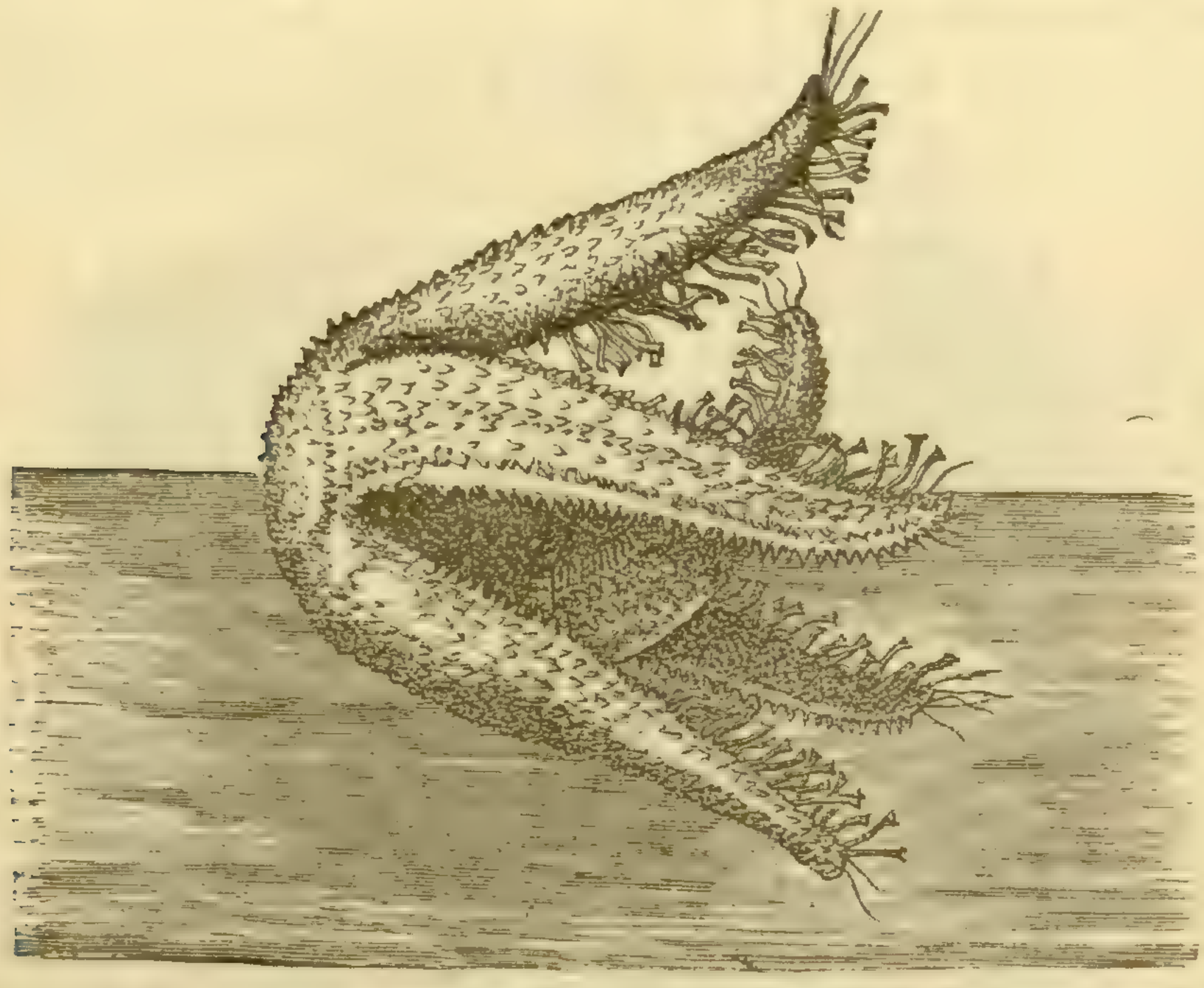

FIG. 14.—Uncoördinated movements of a star-fish in which the nerves of all the rays have been divided.

so secures coördination of feet even in separated segments of the animal.

It was also determined that the so-called eyes of star-fish and

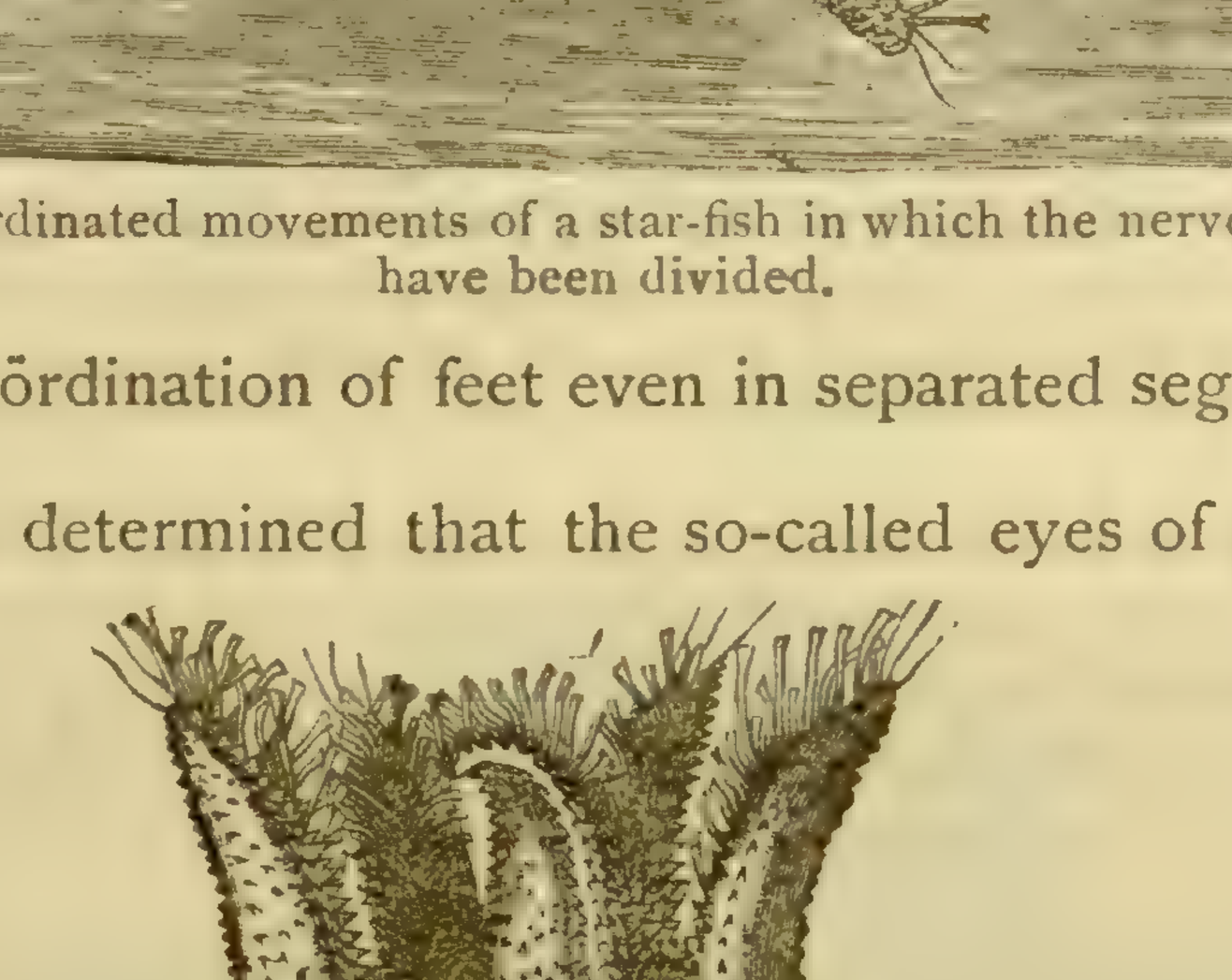

FIG. 15.—Posture frequently assumed when treated as in Fig. 14.

sea-urchins were really such, as if a large tank be completely darkened except at one end where a narrow slit of light is admit-

ted, and a number of star-fish and Echini be scattered over the floor of the tank, in a few hours almost the whole number will be found congregated in the narrow slit of light.

"On removing with a pointed scalpel the eye-spots from a number of star-fish and Echini without otherwise injuring the animals, the latter no longer crawled towards the light, even though this were admitted to the tank in abundance, but they crawled promiscuously in all directions. On the other hand, if only one out of the five eye-spots were left intact, the animals crawled towards the light as before. It may be added that single detached rays of star-fish and fifth-part segments of Echini crawl towards the light in the same manner as entire animals, provided, of course, that the eye-spot is not injured."

Finally, the presence of a sense of smell in star-fish which had been kept fasting for several days, was proved by presenting them with small pieces of shell fish. They immediately crawled to the food, and "if a small piece of the food were held in a pair of forceps and gently withdrawn as the star-fish approached it, the animal could be led about the floor of the tank in any direction." By progressively cutting off the rays and other experiments, it was found that the olfactory sense was equally distributed throughout their length, but along the lower surface.

These researches are certainly of much interest, and are positive additions to our knowledge of the nervous system and of the physiology of these types of life.

JORDAN'S CATALOGUE OF FISHES OF NORTH AMERICA.[1]—This catalogue will be a *sine qua non* of the ichthyologist. It is not only an index to the subject, but a good illustration of a generally rational nomenclature. The number of species now known is 1683. This number will be increased to a moderate extent from fresh and coast waters, and to a greater degree from deep-sea explorations. Thus the take of the Fish Commission steamer *Albatross*, for the past season includes seventy-five species which are not yet described.

Professor Jordan's efforts to do justice to honest work have been in the main successful. While employing such of the names of Rafinesque as are accompanied by recognizable indications; others formerly adopted are rejected, as resting on no sufficient evidence. We think, however, that in a few instances the author has gone a little further in favorable consideration of slip-shod work than justice to good work demands. Thus he adopts the two names Hypsoblennius and Reinhardtius, which were proposed without diagnosis or explanation, in preference to Isesthes and Platysomatichthys, which were defined when proposed. Professor Jordan has not previously taken this position, and he now informs

[1] *Catalogue of the Fishes known to inhabit the waters of North America north of the Tropic of Cancer.* By D. S. JORDAN (Extracted from the Annual Report of the Commissioner of Fish and Fisheries for 1884). 1885, p. 185.

us that it is opposed to his preferences and convictions, as it is to all the rules of nomenclature in existence.

A characteristic which it would be well for American naturalists to imitate, is the classical form and derivation of most of Professor Jordan's names. They display a refreshing contrast to the poverty of invention and barbarous constitution of the handiwork of too many of our countrymen of earlier years. Moreover we do not find the extravagant use of personal names, which has so prevailed of recent years in England and France. The dedication of a species to men of desert, still remains a compliment in this country, whatever it may have become elsewhere.

We append the following special notes apropos of one which appeared in the NATURALIST for 1885, page 814. In this note we did unintentional injustice to Mr. Meek in criticising determinations which we are informed, were mostly made by Professor Jordan. With regard to the *Pantosteus platyrhynchus*, whose characters were said to be due to "shriveling" of the specimen, our objections were well taken; as Professor Jordan informs us that this word is due to a slip of memory, and should be replaced by "soft and limp," the words used in his private notes. Further, Professor Jordan states that he cannot find barbels in either *Meda fulgida* Gir. or *M. argentissima* Cope, as I have described them in the latter, and as Girard failed to observe in the former. The former is very abundant in the San Francisco river, one of the heads of the Gila in New Mexico, where it is the small minnow of the stream. Like Jordan, I find no barbel in any specimen. I have reason to suspect the correctness of the locality given me as that of the *M. argentissima*, *i. e.*, the head waters of the Rio Grande. I suspect it comes from the waters of the Great Colorado. The locality given me for the *Pantosteus guzmaniensis* (*virescens*), "Arkansas river," I have long suspected to be erroneous. I have now reason to believe that it comes from the head waters of the San Juan river, a branch of the Colorado.

Professor Jordan adopts very properly Gill's new order of Lyomeri, for the remarkable Eurypharyngidæ.—*E. D. C.*

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA AND OCEANICA.—*The Badghis.*—The September issue of the Proceedings of the Royal Geographical Society contains a map of the territory about the Heri-rud and Murghab rivers, including the Badghis, which is the district the possession of which is now in dispute between Russia on the one hand, and Afghanistan and England on the other. The country was once well-peopled, but the raids of the Turkoman have made it a desert. Names on the map mark sites, not towns; ruins of forts, caravansaries, houses, or tanks, with only tombstones left to give the history. Most of the streams have two names, one Arab or Persian, the other Turkoman. Along the northern base of the Koh-i-Baba or Paropamisus are a succession of fertile valleys, formerly used for irrigation. Channels and subterranean canals or karezes remain to tell of past cultivation. The streams become salt

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

so soon as they touch a salt deposit which crops up ten to fifteen miles from the range.

Kustik, in a valley about fourteen miles long and three-fourths of a mile wide, is a Jamshidi town; but twenty miles to the east of it commences the Hazara country, a vast plain stretching toward the north, and eroded into a chaos of steep hillocks and hollows by the Murghab drainage. Kala-nau, the chief town of the Hazaras, is a prosperous one. The soil of the Hazara country is excellent—only the manual labor is needed. The Hazaras have enormous flocks of sheep and cattle.

As far back as the earliest periods of Arabic history, Badghis has been connected with Herat. It comprises the land watered by the Murghab and its tributaries. Its principal valley is Penjdeh. The Afghan forts of Bala Murghab and Meruchak are the only modern buildings north of the debouch of the river from the gorge in the Tirband-i-Turkistan, for the Jamshidi and Saryk Turkoman population live entirely in kibiskas or felt tents.

About twenty-eight years ago the Saryks, driven from Merv by the Tekkes, received the sanction of the Jamshidi chief, and located themselves at Penjdeh. These Saryks were once, together with Tekke, Salar and other Turkomans, the scourge of northern Persia, but since Russia has closed the slave marts, they seek for a stable government, and are giving their attention to agriculture. The Saryks own nearly 200,000 sheep.

North of the Badghis, a tract of country between the Murghab and the Heri-rud is called Chol, which is simply Turkoman for a desert that is not a sand desert. The light soil bears short grass almost everywhere until the dry season, and where there is less grass there are usually more bushes, the latter marking a more sandy soil.

The salt lakes of Yar-oilan are situated in depressions, the western one about 950 feet below the surrounding country, and 1430 feet above sea-level, while the eastern one is about 800 feet above sea-level. The beds of these lakes are a mass of hard salt, covered with a very little water. The western lake is the source from which the Tekkes get their salt, while the Saryks use the eastern lake.

In the discussion which followed the reading of Sir Peter Lumsden's paper, Sir Hy. Rawlinson gave his reasons for the identification of Meruchak with the upper Merv or Merv-el-Rud, said to have been founded in the fifth century by Kesra Anushirwan. The larger Merv, now in Russian possession, Balkh and Herat are the three oldest cities of Aryan civilization. The Paropamisus of the Greeks extended no further westward than Herat, the westward continuation being called Sariphe.

At Penjdeh, in a sandstone cliff 200 feet above the river, are some artificial caves, evidently once inhabited. The largest has a central passage 150 feet long, nine wide, and nine high to the top

of the vaulted ceiling. Doorways on each side lead to rooms fifteen to nineteen feet long, and of the same width and height as the passage. Doors were once placed in the entrances, as is proved by the holes for the fastenings. Narrow staircases lead to upper rooms, probably store rooms. Places for lamps remain, and there are traces of soot, but no carvings or inscriptions exist. Many other similar but smaller caves are found all along the valley.

The Carolines.—The Caroline islands were first discovered by a Portuguese navigator in 1526, and during the rest of the sixteenth century were frequently visited by Spanish and Portuguese explorers. They were first named the Carolines by a pilot named Lezcano, about 1686, in honor of Charles II of Spain. Towards the end of the seventeenth century the Spaniards in the Philippines and Mariannes learned something about the Carolines, and an imperfect map of the group was sent to Pope Clement XI in 1705. In 1710 the Jesuits of Manila sent missionaries there, but these, with a few soldiers who accompanied them, were massacred at the Pelews. Though navigators of all nations visited these islands, their number and exact position, as well as the hydrography of the seas in which they were situated, remained unknown until 1817, when they were visited by Kotzebue. After him came Freycinet in 1819, Duperrez in 1824, Dumont d' Urville in 1826, and others, and from these came the first accurate accounts. The group, situated west of the Marshalls, and north of New Guinea, contains about 500 islands, most of which are atolls. The number of real islands is only forty-eight, but as each has a certain number of islets around it, there may be said to be forty-eight groups; forty-three of these are low coral islands, while five are basalt with coral at the base. There are three main groups, separated by two large channels; the principal island of the eastern group is Ponape or Ascension, that of the western Eap, Jap or Yap. Ponape is sixty miles round and has in its centre a peak 2860 feet high. Upon it are some curious ruins, apparently the remains of a large building made of blocks of basalt. There are two rainy seasons, January and August, and the climate is comparatively temperate. The population is from 18,000 to 20,000. The principal elements are Malay and Maori, but there is also a mixture of Negrito and Papuan, and in later times a Japanese and Chinese element was added. The language is also mixed. In some islands there are two languages—the vulgar and the polished. *Tabu* is practised. Each group of islands has its chief, whose power in time of peace is nominal, but in time of war is unbounded.

The Pelews, the most western isles of Micronesia, about 600 miles east of the Philippines, are a group of ten principal islands and a number of islets. The largest island, Babelthuap, is about thirty miles long. All the islands are covered with thick forests. The population is about 3500, and is probably the result of a

mixture of Malays with an inferior race of aborigines. The king has instituted an order, the insignia of which is the first cervical vertebra of a dugong.

An interesting account of these islands will be found in the "Animal Life" of Semper, who spent some time upon them.

M. E. Planchut, in a recent issue of the *Revue Scientifique*, states that the people of the Carolines are in continual relations with those of the Mariannes, which undoubtedly belong to Spain, that the Caroline natives are treated as compatriots when cast upon the Philippines, and that in the eyes of a Spaniard the partition made by Alexander IV is still in force. The entire area of the Carolines, Ualam, Panope, and Kong excepted, would not cover more than 200 miles in length by 200 meters in width. Thus the population is about 500 to the square mile. The same writer states that the people believe in a supreme being, whom they call Machi-machi. Their temples are pyramidal huts with a rough-hewn stone in front, and it is believed that were this stone to be raised by a chief who wished to chastize a mutinous people, the earth would tremble and the sea leave its bed to drown the rebels. M. Planchut states that the Palaos or Pelews have only 1200 inhabitants.

Corea.—Beyond the granite mountains which surround Siril, Mr. Carles has come upon extensive lava sheets covering a large portion of Corea. "There are three great oval fields of lava passing almost in a straight line through the mountain chain which runs from the north to the south of Corea, at a height of about 1500 feet above the sea near the divide, and of 500 feet on the lower levels. There is also another plain about four miles wide and twelve miles long to the east of the Kaun-Söng district, the direction of which is not so well defined, but in which the depth of lava is apparently greater than that in the others." No crater is visible to account for the enormous mass of lava, which must have welled up from extensive fissures.

Asiatic and Oceanic News.—Mr. Gardner, British Consul of Newchwang, estimates the population of Manchuria at 15,000,000. Its three provinces are Heh-lung-Kiang, Kirin, and Fêngtien. The port of Newchwang was opened to trade in 1861.——The Sakeis of Selangore, in the Malay peninsula, seem to have no form of religious worship, but believe in omens. They kill small game with a blow-pipe and dart poisoned with Upas-juice, and large game with a kind of cross-bow formed of a bamboo spear placed in a grooved log, and a bent sapling held back by a rattan cord. This is stretched across a path in the woods. The Sakeis live in bamboo huts thatched with palm-leaves. They are a shy, harmless people, similar in appearance to the Malays, but smaller in statue and with wavy hair.——The Geographical Society of Hamburg, in a recent publication, gives the area of Kaiser Wilhelm's Land or German New Guinea at 34,508 square miles.

The other German annexations in the Pacific are New Ireland, 3398.8 square miles, New Britain, 9348.8 square miles, and the Bismarck archipelago 15,261.6 square miles, in all about 65,512 English geographical square miles. The same authority gives the area of the British annexations in New Guinea at 65,517.76 square miles. Each country has thus annexed a territory about twice the size of Ireland.——Arminius Vambery contributes to the September issue of the Proc. Roy. Geog. Society a list of the names of towns, rivers, etc., in the disputed country between Merv and Herat.——Russian geographical exploration of the Caucasus has begun. MM. Iljin and Dimick have traveled among its glaciers, climbed its passes and given an account of their travels in Petermann's Mittheilungen. Ushba is estimated at 16,500 feet, Tetuuld at 15,500 or thereabouts. The Swanetians, to whose brutality Russian officers fell victims a few years ago, are now quiet. M. Dimick has explored the glaciers of Elbruz. From the resumé of these explorations given by D. W. Freshfield, it does not appear that they add greatly to the work done by Mr. Grove, Captain Telfer, Mr. Phillips-Wolley and Mr. Freshfield.

AFRICA.—*African News.*—Notwithstanding the comparative failure of M. Giraud's expedition, he has added much to our knowledge of Lake Bangweolo and its neighborhood. The form of the lake, as given by him, differs widely from that given by Livingstone, and the Luapula head of the Congo issues from its southern prolongation. M. Giraud has traced it as far as Lake Mœro or Mœro Mkata. It may yet be proven that the Lualuba, may be the true head-stream of the Congo, as, where it issues from Lake Upembe, it has, according to Herr Reichard, a width of 1000 to 1500 feet.——Mr. Grenfell reports that Tippo Tib, the well-known Arab slaver, is evidently preparing for a permanent occupation of Stanley falls. He is making large plantations and is expecting 2000 more men.——From the collections made by M. Humblot during a stay of several months on Great Comoro, it appears that no indigenous mammal is found there. Thirty-four species of birds were found. After an examination of the collections MM. Milne-Edwards and Oustalet came to the conclusion that the fauna has no relation with that of Madagascar, but has been imported from neighboring regions.

AMERICA.—*American News*—Mr. Glaisher has ascended the Berbice river and Wieroonie creek from Georgetown. The banks are thickly populated. After passing some islands the river opens out into wide lake-like expanses of water, the land becoming high. Above the first rapids Mr. Glaisher left the river for its tributary, the Wieroonie creek, which he ascended to within a day's journey of the Demarara river.——M. Violet d' Aouest has discovered in Mexico, on the flanks of the most elevated mountains, argilla-

ceous deposits which could not be attributed to decomposition of the rocks in situ, or to the alluvium deposited by the rivers, or to rain. He attributed them to atmospheric currents. The winds by day raise the particles from the plains, and carry them at night to the hills.

EUROPE.—*European News.*—Sulitjelma, in 67¼° north latitude, and belonging as much to Norway as to Sweden, has hitherto been believed to be the highest Swedish mountain. Last year the topographical surveyor of Norrland found that Sarjekjakko, in Swedish Lapland, is quite 1000 feet higher than Sulitjelma, that is, about 7000 feet. Dr. Svenonius now states that Kebnekaisse, also in Lapland, has been ascertained to be 7300 feet above sea-level.——The rocky islet Munken, three and a half miles south of Sumbö, has completely subsided. The rock is well-known in history. It is mentioned in 1673 by Pastor Lucas Jacobson Debes, and plays a conspicuous part in geographical literature, especially with reference to the Zeni narrative. The islet was formerly seventy feet high, but is now no higher than the surrounding rocks, so that the sea covers it even in fine weather. The shoals around are dangerous, and will now be more so. In 1800 the rock was described as like a ship under full sail when seen from seaward, while from the land it resembled the figure of a monk.

GEOLOGY AND PALÆONTOLOGY.

POLEMICS IN PALÆONTOLOGY.—The present activity in vertebrate palæontology is accompanied by considerable controversy in various directions. M. Lemoine and M. L. Dollo are at issue regarding the identity or non-identity of the genus Champsosaurus Cope and Simœdosaurus Gervais; M. Dollo maintaining their identity and referring to the Champsosaurus, a skeleton found at Erquelines. M. Lemoine states that the Erquelines example comes from an horizon different from that which yielded Simœdosaurus, and that, in order to force an identification, M. Dollo has accused him (M. Lemoine) of errors which he did not commit. On the identity of the American and Cernaysien forms M. Lemoine reserves his opinion. M. Dollo answers by asserting the identity of horizon of the French and Belgian specimens, and giving reasons for considering the remains as belonging to the same species. Passing in review the cranium, atlas and axis, vertebræ, scapula and coracoid, and other parts, he not only denies the existence of any proved divergence between the American, Cernaysien and Belgian examples, but declares that the bones described by M. Lemoine as scapula and coracoid are really not those bones, since they are shown as placed one over the other, whereas there is a true articulation between the actual scapula and the coracoid. He suggests that the scapula of M. Lemoine may be a part of the coracoid.

Dr. Schlosser, of Munich, endeavors to show that Dr. Lydekker is in error in proposing, in the catalogue of the vertebrate fossils in the British Museum, to combine certain species of Rodentia, described by him in his monograph of the Tertiary Rodentia of Europe.

Dr. Lydekker, in the London *Geological Magazine*, reviews the illustrated papers published by Professor Cope in the AMERICAN NATURALIST on American fossil Vertebrata. He differs generally with the systematic views of Professor Cope, and diverges even more from him in his nomenclature. This paper will be answered by Professor Cope. Dr. Lydekker affirms the identity of Hyopsodus Leidy with Microchœrus Wood; and of Esthonyx Cope with Miolophus Owen. Professor Cope, in a note to the *Geological Magazine*, shows that there is not sufficient ground for the latter identification.

Dr. Baur believes that the bone in Iguanodon supposed by Marsh to be clavicle, is really sternum, as indicated by Dollo.

THE ANKLE AND SKIN OF THE DINOSAUR, DICLONIUS MIRABILIS.—The fibula of this saurian lies at its distal end in a groove of the external part of the front of the tibia. It is compressed so as to be anteroposterior. It terminates in an epiphysis-like calcaneum. The astragalus has the usual form, and embraces the tibia closely. Its anterior ascending process is rather short and thin. Posteriorly the tibia rests on the astragalus and is not overlapped by it. A portion of the extremity descends and fills an angular space which enters between the astragalus and calcaneum behind, and takes part in the ankle-joint. This does not occur in the *Ornithotarsus immanis*.

A portion of the integument from the pelvic region of this dinosaurian is preserved. It is indicated by a thin brown layer like the remains of corneous teeth, which I have described as existing in the premaxillary region.[1] It is in the form of small sub-pentagonal disk-like scales, each with a beveled and coarsely crenate margin. They do not fit closely except at the interior or basal part of their edges. The scales resemble considerably the divisions of the skin of *Rhinocerus sondaicus*. The scales are about a centimeter in diameter.—*E. D. Cope.*

PLIOCENE HORSES OF SOUTHWESTERN TEXAS.—The pliocene beds of Southwestern Texas have yielded several interesting species of Mammalia. Among these may be mentioned *Mastodon americanus* Cuv. and *M. serridens* Cope,[2] and *Cistudo marnockii* Cope. But horses of the genus Equus are the most numerous in species and individuals. The following identifications are based on specimens received from Messrs. Wm. Taylor and G. W. Marnock, to whom I hereby express my acknowledgments.

[1] Proceedings Academy Philadelphia, 1883, p. 104.

[2] NATURALIST, 1884, p. 525.

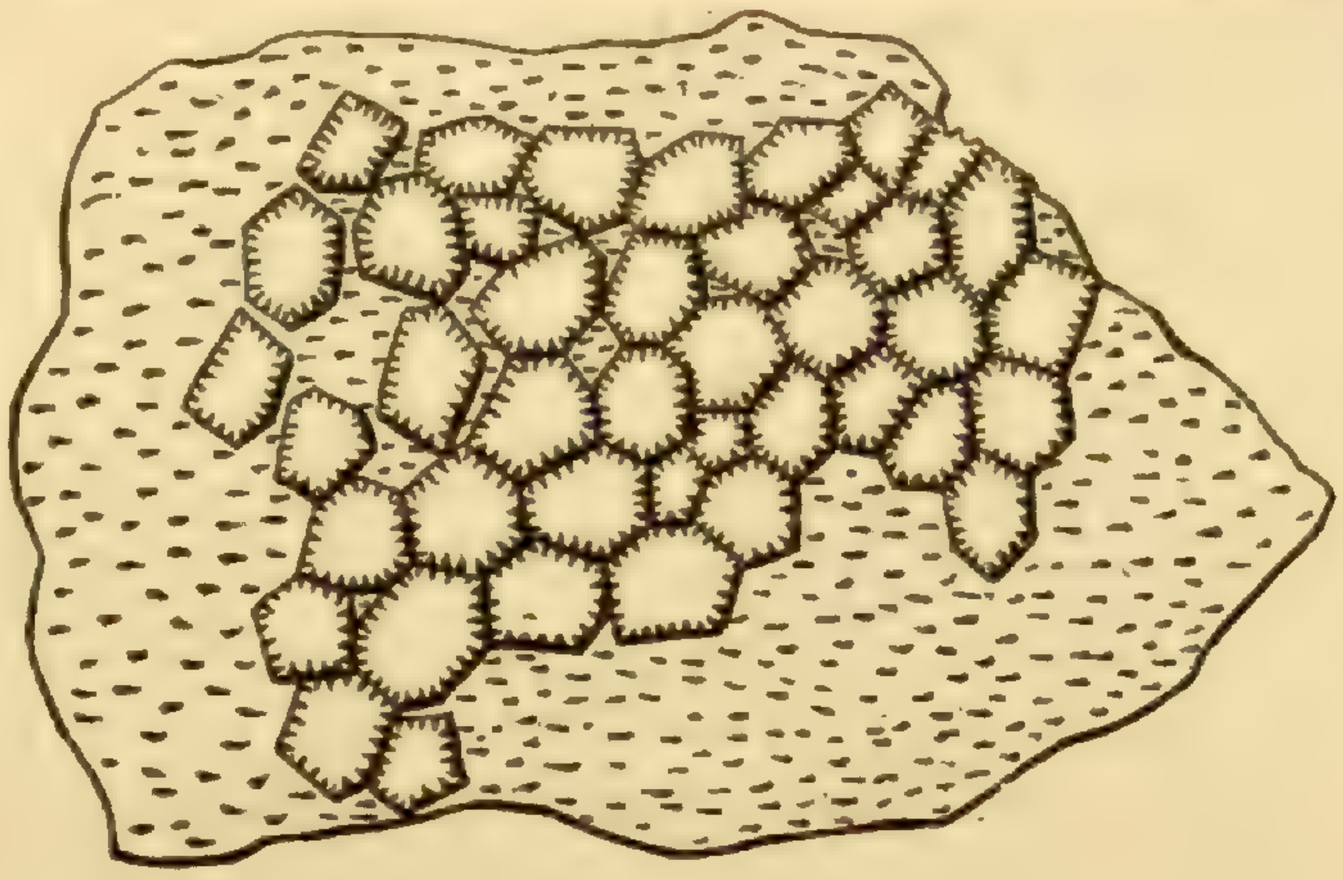


Fig. 1.

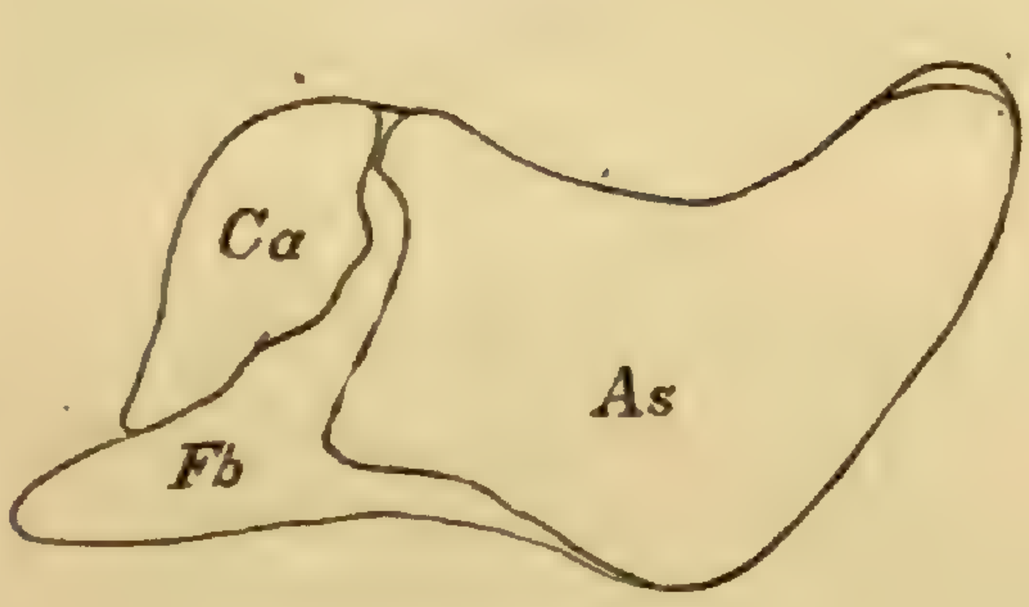


Fig. 2.

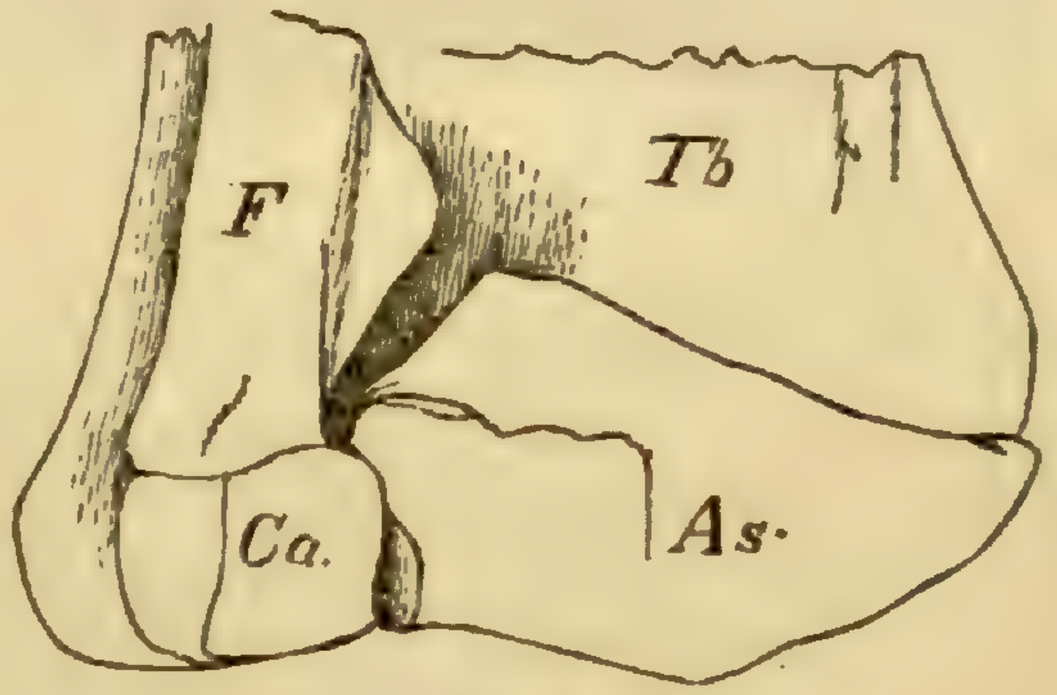


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

FIG. 1.—Portion of the skin of *Diclonius mirabilis*, three-fourths natural size. FIGS. 2, 3.—Extremity of fibula and tibio-tarsus of do., one-seventh nat. size; 2 from below, 3 from front; *Tb*, tibia; *F*, fibula; *As*, astragalus; *Ca*, calcaneum. FIG. 4.—*Equus crenidens ?* Cope: grinding face of superior molar tooth, nat. size. FIG. 5.—Superior molar tooth of right side of *Hippotherium peninsulatum* Cope; grinding surface from below, natural size. FIG. 6.—The same of *Protohippus castilli* Cope; same view, natural size.

EQUUS BARCENAEI Cope. Proceeds. Amer. Philos. Society, 1884, pp. 10–15. One superior molar. Hitherto only known from the valley of Mexico. From Mr. Marnock.

EQUUS FRATERNUS Leidy, 1858. *E. tau* and? *conversidens* Owen, 1869. From Mr. Marnock.

EQUUS EXCELSUS Leidy. Approaches the last named species. From Mr. Taylor.

EQUUS OCCIDENTALIS Leidy. The most southern and eastern locality for this species, which has not hitherto been found away from California and the Great Basin. One very characteristic superior molar, from Mr. Taylor.

EQUUS? CRENIDENS Cope. Proceedings Amer. Philosoph. Society, 1884, p. 10–12.

This or a nearly allied species is represented by a single, and the largest, superior molar tooth of a horse which I have seen or find recorded. The .measurements exceed those of the typical *E. crenidens* (which has not, so far, been found out of the Valley of Mexico), and there are some other differences in the distribution of the enamel-folds. It is distinguished from the other species of Equus by the small diameters and concaved inner border of the anterior internal column, by the simplicity of the enamel-folds, and the crenate character of the margins of the lakes, together with the large dimensions. The crenation is less obvious in some specimens than in others, and in the one here noticed is almost confined to the borders of the posterior lake. The diameters of the crown measure: anteroposterior, 41^{mm}; transverse, 37^{mm}; length, 120^{mm}.

Fig. 4, Plate XXXVII, represents the grinding face in outline.

Of the five species of Equus of Southwestern Texas, four have been found in the pliocene of the Valley of Mexico, and one is peculiar to the Pacific coast and basin of North America. Of the characteristic species of the Eastern United States, *E. fraternus* and *E. major*, the former only has been found. (For comparison I introduce Figs. 5 and 6, Pl. XXXVII, of three toed horses from the Loup Fork bed of Mexico. See Proceeds. Amer. Philos. Soc., Oct., 1885.)—*E. D. Cope.*

LIST OF THE GEOLOGICAL FORMATIONS OF SPITZBERGEN.[1]—*Quaternary system.*—Beds of sand and clay with remains of terrestrial plants, marine shells and weeds (some species not living at present on Spitzbergen, *e. gr.*, *Littorina littorea*, *Mytilus edulis*, and *Fucus canaliculatus*), "Blomstrand's beds," "beds of the Reindeer valley," etc.

Miocene system.—Sandstones, schists, etc., at King's bay, Cape Staratschin, Cape Heer, Heer's mount, Cape Lyell, Scott's glacier, with more than 200 sp. of fossil plants, *e. gr.*, Equisetum, Sequoia, Taxodium, Glyptostrobus, Pinus, Acorus, Iris, Acer, Platanus, Tilia, Corylus, Populus, Grevia, Hedera, etc.

Cretaceous system.—Sandstone at "the Fastness" (ice fiord)

[1] According to Osw. Heer's Flora Fossilis Arctica, and the discoveries of the Swedish expeditions by O. Torell, A. E. Nordenskiöld, C. W. Blomstrand, A. Nathorst, P. Oberg and G. Nauckhoff.

with about twenty sp. fossil plants, among which *Sequoia reichenbachii.*

Jurassic system.—1. Upper beds: The beds at Cape Boheman with fossil plants, *e. gr.*, *Ginko digitata*, Pinus, Podozamites, Scleropteris, etc. 2. Lower beds: The marine beds of Cape Staratschin, Green harbor, Advent bay, Sassen bay, Cape Agardh, with Ammonites, Belemnites, Cardium, Leda, Inoceramus, Aucella, Pecten, Ophiura, etc.

Triassic system.—Bituminous limestones and schists of Cape Thordsen, Saurie hook, Cape Staratschin, Cape Lee, Whales point, with bones of Reptilia, *e. gr.*, Ichthyosaurus, Acrodus, etc.; and Mollusca, *e. gr.*, Ammonites, Ceratites, Daonella, Halobia, Pecten, Lingula, etc., and with beds of phosphates of lime.

Carboniferous system.—1. Upper beds: Sandstones, schists, etc., at Recherche bay, with vegetable fossils, *e. gr.*, Lepidodendron, Lepidostrobus, Stigmaria, Cordaites, Rhabdocarpus, Adiantites, Sphenopteris, etc. 2. Calcareous beds with Productus, Spirifer, Rhynchonella, Chonetes, Euomphalus, etc.; limestones, sandstones, schists, gypsum and silex of Beeren island, South cape, Horn sound, Bell sound, Ice fjord, King's bay, Henloopen strait, Stansforeland, etc. 3. Lower beds ("palæanthracitic beds," "ursastuffe"): Schists, sandstones and coals of Beeren eiland, Klaas Billen bay and Bell sound, with Lepidodendron, Stigmaria, Calamites, Cyclostigma, Knorria, Cardiopteris.

Devonian system? ("The Liefde bay formation").—Green and red schists, red sandstones and limestones at Liefde bay, Wijde bay, Dickson bay, Klaas Billen bay and Beeren eiland, with indeterminable fish-scales and bivalves.

Silurian system? ("The Hecla Hook formation").—Quartzites, dolomites and black schists from different localities, and containing indeterminable bivalves. The whole western part of Spitzbergen and the Northeastland.

Primitive system.—Gneiss, mica schists, quartzites, marbles, dioritic schists, granites, etc, of the N. E. part of Spitzbergen, North cape, Seven islands, etc.—*J. Lindahl.*

Geological News.—*General.*—G. F. Becker (*Amer. Journ. of Science*, Sept., 1884) has a note upon the relations of the mineral belts of the Pacific slope to the great upheavals. A great majority of all the profitable ore deposits west of the crest of the Wasatch occur in belts a few miles in width which follow the western edges of distinct geological areas. Thus the lead-silver belt of Utah follows the Cretaceous, the belts of Nevada and Arizona the Palæozoic, and usually the Carboniferous; the gold belt of Eastern California the Jura-trias, and the quicksilver belt of Eastern California the Tertiary.——*Psyche* contains a contribution to the geological history of myriopods and arachnids, by S. H. Scudder. The group Archipolypoda resemble the Diplopoda in having two pairs of legs on every segment; while in the Proto-

sygnatha only a single pair of legs is borne by each segment, and the group thus resembles the Chilopoda. For a brief period after leaving the egg, modern diplopods and pauropods have a shorter body than in after life, and the first three segments bear but a single pair of legs. In adult life these first three segments still bear but a single pair of limbs, while all the other segments, both those which exist in the larval state and those which develop afterwards, bear two pairs. The Chilopoda have these same three anterior pairs of limbs early and permanently developed as organs of manducation, while all other segments have but a single pair. Palæontological evidence is in favor of the view that the dorsal scutes of Diplopoda are compound. The archipolypodous type is the oldest, and there is evidence that some of the Carboniferous forms were amphibious. The group culminated in the Carboniferous, and does not appear to occur later than the Dyas, while, with one doubtful exception, no true diplopod is known to be older than the Oligocene.——According to S. H. Scudder between twenty and thirty species of pre-Tertiary Arachnida are now known, and the earlier forms, chiefly of Carboniferous age, belong either to the scorpionides or to the Anthracomarti, a group which is not known later than Palæozoic times, the only Mesozoic arachnids yet known being true spiders. In the amber deposits of Prussia all the suborders of Arachnida occur except the Pedipalpi and the already extinct Anthracomarti.——Sr. G. B. Villa (Atti. d. Soc. di Sci. Nat.) gives a review of the rocks of Brianza (Italy) with a list of the principal fossils of each horizon from the Trias to the most recent strata.

Mesozoic.—Bulletin No. 19 of the U. S. Geological Survey consists of notes on the stratigraphy of California, by G. F. Becker. The metamorphic rocks of the coast ranges often show proof that plication was not effected by flexure but by innumerable fractures, the resulting small fragments being retained in their approximately original position by mutual pressure and afterwards re-cemented by silica. The Knoxville beds, the age of which is near the limits of the Jurassic and Cretaceous, are the youngest beds of the coast ranges which are known to have experienced the peculiar magnesian and siliceous metamorphism of these ranges. The overlying Chico beds are shown to be nonconformable with the Knoxville beds, and over wide areas the Chico, Tejon and Miocene strata seem to be perfectly conformable with each other. The upheaval and metamorphosis of the Knoxville strata is referred to the close of the period of their deposition. The auriferous beds of Mariposa are referred to the same horizon as the Knoxville beds. It is maintained that there has been a great east and west compression of the country, connected with the great faults in the Wasatch and the Sierra, while a land barrier existed in the position of the Sierras from a time prior to the Cretaceous onward, and accounts for the difference

in the faunas of the Pacific Coast waters and those eastward of them. The Sierras and Coast ranges are referred to a single mountain system.——A. D. Achiardi gives the particulars of an examination into the macroscopical and microscopical characters of the trachyte and quartziferous porphyry of Donoratice, near Pisa, Italy. The trachyte is covered, here and there only, with Eocene sediments which seem to have been disturbed by the eruption. The porphyry traverses the parti-colored schists of the Upper Lias and also the marbles of the Lower Lias, and is only about 400 meters distant from the trachyte, the space between being occupied by Eocene sediments. D'Achiardi finds the materials of these two rocks to be chemically the same, and the mineral species contained in them, for the most part, identical, but while the trachyte has cooled rapidly upon the surface of the rocks, the porphyry was intruded through them, and cooled slowly. The same mineralogist notes the presence in the Apuan Alps of tormalinolite.

Tertiary.—Mr. W. Whitaker, in a Note on the Red crag of Norfolk, Eng., states that the unfossiliferous sand upon the surface of the crag is identical with the sand of the shelly crag below, which has not been eroded by surface waters before the deposition of the upper beds, but dissolved by the action of carbonated water after the overlying beds were deposited.

Glacial.—Professor J. E. Todd (Proc. Amer. Assoc., 1884) describes the geology and geography of the Missouri coteau, which he states to be neither a high plateau nor a typical one. It is built mostly of Cretaceous clays of the St. Pierre group, capped northward with thin even layers of Fox Hills sandstone, and southward with Loup River sandstone. Two moraines are quite easily traceable upon it, and these, from their elevation, position and general features are probably equivalent to the Altamont and Gary moraines named by Professor T. C. Chamberlin on the Coteau des Prairies. The outer moraine is the more pronounced, consisting of loops, convex usually toward the west and south, but in rare cases toward the north-west. Traces of four great lobes of the ice-sheet, pushing through from the James to the Missouri, can be found.

MINERALOGY AND PETROGRAPHY.[1]

METEORITES.—A number of very important contributions to the literature of these interesting bodies, which reach our globe directly from the regions of space, have recently been published. Papers relating to meteorites have heretofore been largely confined to detailed descriptions of particular falls. With the exception of Rose's essay on the classification of these bodies, little of a general nature regarding them has been produced until within the past year or two. Now, however, we have at least four

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins Univ., Baltimore, Md.

extensive works dealing with their classification and the results of their microscopical and chemical study. These are, moreover, quite different in their aim and scope.

First may be mentioned Dr. M. E. Wadsworth's Lithological Studies,[1] the first part of which, published in October, 1884, contains much useful information regarding meteorites. The results of the microscopical study of thin sections of these bodies by many investigators, as well as by Dr. Wadsworth himself, are here brought together in convenient form. They are very properly classified with terrestrial rocks as a part of the same series, in which they also represent certain members more basic than any found in the earth's crust near its surface.

Probably the work which will do most to spread abroad just and accurate ideas of the exact nature and mineralogical composition of the meteorites, is the series of microphotographs recently published by Professor G. Tschermak, of Vienna.[2] There is scarcely any one to whom a richer collection of this rare material was accessible, nor any one better fitted by his own researches for successfully preparing such a volume. Thin sections, one hundred in number, illustrating every phase of structure and composition met with among meteoric stones, have been reproduced so admirably by photography as to afford the best possible substitute for the originals. When it is remembered how few can ever hope to thoroughly study sections of meteorites themselves under the microscope, the value of these photographs, which necessarily far exceed any possible descriptions, will be appreciated. Each plate is accompanied by a full explanatory text. The work was executed by J. Grimm, of Offenburg, who is already well known for his superb microphotographs of rock sections, edited by Professor E. Cohen. The same firm promises a similar set to illustrate the structure of meteoric irons, the appearance of which will be awaited with interest.

Professor Staislas Meunier, of Paris, has recently published an elaborate work entitled " Les Météorites."[3] In this he presents a new classification, as well as his views respecting the origin of these bodies. The latter agree with those of Reichenbach, Haidinger and Tschermak in considering meteorites, at least such as possess a breccia-like appearance, as aggregations of much smaller bodies of matter distributed through space, which have been brought together by their mutual attraction.

Another extremely important paper on meteorites is that by Dr. Aristides Brezina, curator of the royal mineralogical cabinet

[1] Memoirs Mus. Comp. Zool. at Harvard Col. Vol. XI, pt. I, Oct., 1884.

[2] Die mikroskopische Beschaffenheit der Meteoriten, erläutert durch photographische Abbildungen. Stuttgart, 1885.

[3] Les Météorites. Paris, 1884. Appendix to Vol. II of Fremy's Encyclopédie Chimique.

of Vienna.[1] This is ostensibly a report on the condition of the meteoric collection belonging to the cabinet, but really contains much matter of very general interest. Brezina can find nothing in the structure of the meteorites to indicate a secondary or conglomerate nature. He regards them as the product of a very rapid crystallization from a homogeneous magma. Respecting their origin, he considers the old theory of Chladni (1818) and von Hoff (1835) as the most probable. According to this the meteorites reach the external atmosphere of the earth as dust-like or gaseous agglomerations, which, by the sudden diminution of their cosmic velocity, are enormously heated and at the same time condensed into solid bodies. The classification adopted is in the main a petrographical one, following in the principal groups those of Rose and Tschermak. Many new subdivisions are, however, introduced to cover the results of the more thorough and elaborate study. The meteoritic collection in Vienna is the largest in the world, representing 358 localities, while that of London has 350 and that of Paris 300.

Short notices have recently appeared by Professor C. U. Shepard, on the Fomatlán, Jalisco, Mexico meteorite (which fell August, 1879), which is composed largely of olivine and octahedral crystals of nickeliferous iron;[2] also by the same writer on the meteoric iron of Trinity county, California.[3] Meteoric irons have also been described and analyzed by N. T. Lupton from Santa Rosa, Mexico;[4] by George F. Kunz, from Glorietta Mt., Santa Fé county,[5] New Mexico; and by R. B. Riggs, from Grand Rapids, Michigan.[6]

Mineralogical News.—All mineralogists will be glad to welcome the new and enlarged edition of Professor P. Groth's invaluable treatise on physical crystallography.[7] This work, which has done such good service ever since its appearance in 1876, has been partially rewritten and considerably extended, especially by its descriptions of all the newest methods and apparatus for mineralogical investigation.——The admirable text book of mineralogy by Professor G. Tschermak, published in 1884, has become so popular that a second enlarged edition of it has already appeared.[8]——Professor J. Hirschwald, of Berlin, has issued a systematic description of the mineral collection of the Royal Technical High School, which will be of service to all mineral-

[1] Die Meteoritensammlung des k. k. mineralogischen Hofkabinets in Wien am 1 Mai, 1885. Jahrbuch der k. k. Geol. Reichsanstalt, XXXV, p. 126, 1885.

[2] *Am. Jour. Science*, Aug., 1885.

[3] Ib., June, 1885.

[4] Ib., March, 1885.

[5] Ib., September, 1885.

[6] Ib., October, 1885.

[7] Physikalische Krystallographie. Zweite auflage. Leipzig, 1885.

[8] Lehrbuch der Mineralogie. 2te Auflage. Wien, 1885. pp. 598.

ogists and collectors.[1]——F. Rinne concludes that crystals of milarite, which are apparently hexagonal, were really so at the time of their formation, and that their molecular disturbance is due to a subsequent change of conditions, as is true in the case of leucite and boracite.[2]

PETROGRAPHICAL NEWS.—The second part of the second volume of Professor J. Roth's Allgemeine Chemische Geologie has just appeared. This treats of the younger eruptive rocks, and especially on account of the wonderful completeness of its literature references, will form, as do the other parts of the same work, a most valuable addition to the library of every working geologist and mineralogist.——A very concise elementary textbook of microscopical petrography has recently appeared, by Professor A. von Lasaulx, of Bonn.[3] In spite of its small size it brings the essential points of this rapidly developing science down to date, and is especially to be recommended for its full bibliography.——In his recent exhaustive optical study of the mineral leucite, Professor C. Klein, of Göttingen, describes in some detail a new and very complete mineralogical and petrographical microscope, which is constructed by the well-known firm of Voigt & Hochgesang, of Göttingen.[4] This instrument, of which a cut is given in their latest catalogue (1885), may be had for 800 marks ($200), and is undoubtedly the most satisfactory microscope in the market for the especial uses for which it is intended.——Fr. Becke, of the University of Czernowitz, contributes a paper on the twinning of rock-forming pyroxene and amphibole.[5] He finds in certain Hungarian pyroxene andesites that the bronzite crystals are frequently grouped in radiating groups, in accordance with three twinning laws, viz: twinning planes 1, $P\overline{\infty}$ (vom Rath); 2, $\frac{2}{3}P\overline{\infty}$, and 3, $\frac{4}{3}P\infty$. The first of these is the most common and corresponds very closely to the twinning law for augite, twinning plane P2. The frequently mentioned twins of augite and hornblende in rocks, with a composition—face apparently inclined to the vertical axis, the writer follows Mr. George F. Becker[6] in considering merely ordinary twins, parallel to $\infty P\overline{\infty}$, which are cut in the section parallel to some pyramidal face.——J. H. Kloss, of Karlsruhe, has made some interesting contributions to the subject of secondary hornblende in rocks.[7] He finds abundant evidence of compact as well as fibrous hornblende (uralite) originating from the paramorphosis of pyroxene, and can

[1] Das mineralogische Museum der Könl. tech. Hochschule. Berlin, 1885.
[2] Neues Jahrbuch für Min., etc., 1885. II, p. 1.
[3] Einführung in die Gestenislehre: Ein Leitfaden für den akademischen Unterricht und zum Selktstudium. pp. 215. Breslau, 1885.
[4] Neues Jahrbuch für Min., etc., Beil. Bd. III, p. 540.
[5] Tschermak's. Min. und Petrog. Mitth., VII, 93. 1885.
[6] Geology of the Comstock Lode. Monographs U. S. G. S., Vol. III, p. 113, pl. IV, fig. 28.
[7] Neues Jahrbuch für Min., etc., 1885. II, p. 82. Versammlung deutscher Naturforscher und Ærtze in Strassburg. Sept. 18–23, 1885.

see no reason why a single, homogeneous individual of the former mineral should not replace one of the latter. He furthermore thinks that such secondary hornblende (which cannot be regarded as an alteration product in the common sense), should be used for purposes of rock classification, and suggests names as uralitite, uralite-diabase, uralite-gabbro, etc., to be employed, of course, only where the secondary nature of the hornblende was beyond doubt.——Professor C. R. Van Hise, of Madison, publishes an important paper on the secondary enlargement of hornblende fragments in clastic rocks[1] altogether analogous to those which he and Professor R. D. Irving have previously described as occurring in the case of quartz and feldspar.[2] In certain conglomerates of Northern Minnesota hornblende fragments have been enlarged by the deposition of their own substance from solution in such a manner that the crystallographic and optical orientation of the crystal is retained, and twinning lamellæ are even continued into the newly-formed portion.——Professor J. W. Judd, of London, continues his studies of the eruptive rocks of the West of Scotland, in an interesting paper on the Tertiary and older Peridotites.[3] Aside from the great interest attaching to these rocks from their being of Tertiary age, Professor Judd calls attention to their remarkable freshness as calculated to throw light upon the original form of the minerals of the more basic massive rocks. Many of these, like labradorite, olivine, hypersthene and diallage, are well known to often possess a peculiar luster on cleavage surfaces due to the presence of inclusions. These are generally regarded as original in their nature, but Professor Judd considers them as secondary. He thinks that at great depths, under the action of pressure, circulating waters would have such an increased solvent effect that in certain planes a portion of the crystalline substance would be dissolved, leaving cavities of regular shape, resembling in their nature the "etched figures" which are produced in crystalline planes by the action of certain reagents. Into these cavities, or negative crystals, foreign matter is infiltrated, thus producing the so-called inclusions of indeterminable microlites. This process is designated as "*schillerization.*"——Messrs. Hague and Iddings contribute a most important paper on the development of crystallization in the igneous rocks of Washoe, Nevada,[4] to which no justice can be done here. Their main point is the convincing evidence they adduce to show that one and the same eruptive mass may solidify in a glassy form at the surface, and with a holocrystalline structure—even a coarsely crystalline structure—at great depths. The two forms are connected by every transitional stage.

[1] *American Journal Sci.*, Sept., 1885.
[2] Bulletin of the U. S. Geol. Surv., No. 8.
[3] Quarterly Journal of the Geol. Soc., Aug., 1885.
[4] Bulletin U. S. Geological Survey, No. 17. Washington, 1885.

BOTANY.[1]

THE GRASSES OF MAINE.—Under this title Professor Fernald, of the Maine State College, has brought out a neat pamphlet of seventy pages and forty plates. It is designed for the use of the author's students, as well as for the farmers of the State. In the introduction is given a general description of the structure of grasses, with a pretty complete list of the technical terms used in ordinary descriptive works, and a couple of pages on the composition of grasses. An analytical key precedes the descriptive portion of the book, the latter occupying about fifty pages. Common names and the pronunciation of the scientific names are given in every case. The descriptions are much simplified, and appear to be fairly accurate. Short notes upon their agricultural value follow each species. Eighty-one species belonging to thirty-eight genera are described, and of these forty-two species are figured in the plates borrowed from the department of agriculture at Washington.

THE SPECTRUM OF CHLOROPHYLL.—When a ray of white light which has passed through a coloring-matter, for instance, a solution of one of the coal-tar dyes, red wine, or a solution of chlorophyll, is examined by means of a spectroscope, certain dark bands, known as absorption-bands, are observed at definite places in its spectrum. For convenience in examining the spectra of small amounts of coloring matters, a direct vision spectroscope attached to the tube of a microscope is employed, and the coloring-matter in question is placed in a flat-walled bottle or a glass cell on the stage of the microscope. The ray of light which is reflected from the mirror under the stage passes first through the colored matter, next through the objective, and lastly through the prisms which compose the microspectroscopic attachment to the tube.

In order to compare the spectra of different substances, a second prism or set of prisms is often used, by which the spectrum of a second liquid can be projected by the side of that of the first. The spectra of chlorophyll solutions from two different sources can thus be at once compared. One of the combinations can also be employed to project the solar spectrum (unchanged by passing through any color whatever), and its constant lines (Fraunhofer's lines) can be used for the determination of position of the bands seen in the spectrum of the liquid by its side.

The spectra of many substances, among which chlorophyll occupies a prominent place, have absorption-bands of such constancy in position and appearance that they are justly regarded as characteristic. The spectrum of an alcoholic solution of chlorophyll has been shown to be essentially the same as that of the chlorophyll granule itself. In order, however, to obtain all

[1] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

the absorption-bands characteristic of chlorophyll, it is necessary to examine successively solutions of different degrees of strength, some of the bands appearing only in dilute, and others only in strong solutions.—*G. L. Goodale, in Bot. Text-Book.*

The Treatment of Sets of Botanical Specimens.—In this day, when so many sets of plants are distributed by the many collectors and elaborators of groups, it becomes a serious question what to do with them in the herbarium. A single set, or even a few sets may be kept in the original form and consulted in this way, but when one has to ransack a dozen or more fascicles, in as many different sets, in order to make a comparison of the species of a particular genus, the trouble is entirely too much for a busy man. One dislikes to tear up his sets of Ellis' North American Fungi, Thuemen's Mycotheca Universalis, Linhart's Ungarns Pilze, Wittrock and Nordstedt's Algæ aquæ dulcis exsiccatæ, Rabenhorst's Algæ Sachsens and Algæ Europas, etc., etc., but really the labor of running over the numerous fascicles makes any other course impracticable. In the herbarium of the University of Nebraska, all sets of plants, of whatever groups, are cut up and distributed. The labels in all cases are distinctive, indicating with certainty the set to which each specimen belongs, and its serial number. Any specimen can thus be as readily referred to as if it were retained in the original fascicle, while the ease of consultation and comparison is greatly enhanced.

Botanical Notes.—The botanical portion of the second annual report of the Wisconsin Agricultural Experiment Station, by Professor Trelease, is mainly devoted to the spot-disease of strawberry leaves (*Ramularia tulasnei*). Three figures serve to make the descriptions much more easily understood, although the text is admirably clear. A paper of this kind is worth more than scores of pages of so-called "experiments," which too often constitute the bulk of the reports from American experiment stations.——J. G. Baker's synopsis of the genus Selaginella, which has been running through the *Journal of Botany* for many months, is brought to a close in the October number. The whole number of species described is 312, of which 105 are here described for the first time.——B. M. Everhart, of West Chester, Pa., has compiled an alphabetical index to the species of the first fifteen centuries of Ellis' North American Fungi. It will prove of great service to all who have occasion to refer to Ellis' specimens. From it we find that there are in the fifteen centuries thus far published twenty-five species of Peronospora, eighty of Puccinia, twenty-eight of Uromyces, fourteen of Ustilago, forty-seven of Polyporus, eighty of Peziza, etc., etc.——Professor Beal has published in Bulletin No. 5, of the Michigan Agricultural College, the results of experiments made upon the vitality of seeds, from which it appears that of seeds enclosed in sand in bottles and

buried twenty inches below the surface of the soil, at the end of five years the following per cents grew, viz: Of *Amarantus retroflexus*, forty-two; *Ambrosia artemisiæfolia*, none; *Brassica nigra*, none; *Bromus secalinus*, none; *Capsella bursa-pastoris*, one hundred; *Lepidium virginicum*, ninety-four; *Erechthites hieracifolia*, none; *Euphorbia maculata*, none; *Lychnis githago*, none; *Anthemis cotula*, fifty-two; *Malva rotundifolia*, two (?); *Œnothera biennis*, eighty-two; *Plantago major*, none; *Polygonum hydropiper*, six; *Portulaca oleracea*, thirty-eight; *Quercus rubra*, none; *Rumex crispus*, ninety; *Setaria glauca*, sixty-eight; *Stellaria media*, seventy-two; *Thuja occidentalis*, none; *Trifolium repens*, four; *Verbascum thapsus*, eighty-four.——From the proceedings of the U. S. National Museum, we have a list, by Frank H. Knowlton, of the plants collected by C. L. McKay in Alaska, in 1881. In all 122 species are enumerated, distributed as follows, viz: Dicotyledons, eighty-seven; Monocotyledons, twenty-four; Conifers, one; Pteridophytes, five (one Equisetum, one Lycopodium, three ferns); mosses, four; lichens, one. No new species are described.——Professor Penhallow published, in the *Canadian Record of Science* for October, a paper upon the distribution of the reserve-material of plants in relation to disease, from which it appears that an abnormal storage of starch in the pith, wood and bark of the peach is associated with a deficiency of potash and chlorine and an excess of lime. This abnormal storage is accompanied apparently by imperfect nutrition, due to the loss of power of the tissues to dissolve the starch, which accordingly accumulates.——The July *Torrey Bulletin* contains a paper by Professor Trelease showing that the fungus parasitic on *Juncus tenuis*, and hitherto known as *Ustilago junci* Schweinitz, is properly not an Ustilago at all, but a species of Cintractia. Accordingly it must hereafter be known under the name of *Cintractia junci* (Schwein.) Trelease. The only other known species of the genus is *C. axicola* (B) Cornu, from the southern United States and the West Indies.——From a study of the development of the leaves of *Pinus monophylla* and *P. edulis* upon young trees growing upon his grounds in Germantown, Pa., Thomas Meehan concludes that the former is a depauperate state of the latter. His paper appears in the August *Torrey Bulletin*.——The "Association Number" of the *Botamcal Gazette* (Sept. and Oct.) contains forty-six pages of interesting matter. We are much pleased to read the announcement that beginning with the new year the size of this indispensable journal will be increased to at least twenty-four pages per month. An exhaustive index to volumes I to X will be published at the close of the present year. ——Professor John M. Coulter's Rocky Mountain Flora is in press, and will soon appear. It is to be uniform with Gray's and Chapman's Manuals, and will include descriptions of the plants from about the 100th meridian westward, and extending from British America southward through Colorado.

ENTOMOLOGY.

Occurrence of Colias nastes in the Pamir mountains.—In the Investia of the Russian Geographical Society is a paper by M. Grum-Grzimailo, who has journeyed, says *Nature*, in the mountains north of the Alay region of the Pamir, in Central Asia. On a rich Alpine pasturage, where Kirghizes are in the habit of staying, he found *Colias eogene*, *Arctia erschoffi*, etc., which are common almost exclusively to the Himalayas and the Southwest Thian-Shan. On the plateau between the Kara-Su and the Aram, with other rare Lepidoptera were species of Colias and Parnassius. On the Dje Kaindy pass, the Lycaenæ were numerous, so that in the space of three meters the author found fifteen species of them, of which three were unknown to him. Another find of great interest was that of *C. nastes*. The late Mr. Fedchenko had already caught one female butterfly, which was determined by M. Erschoff as *Colias nastes*. This species having been found formerly only in Labrador and Northern Lapland, the determination remained doubtful, the individual having been but a female. M. Grzimailo has caught a number of both males and females, which really proved both to belong to *C. nastes*. The writer says it remains now to explain the strange extension of this species. He does not seem to be aware that several (nine species) other Labrador Lepidoptera occur in the Altai mountains of Northeastern Asia.

The Eye and Optic Tract of Insects.—In his essay on this subject Dr. S. J. Hickson (Quart. Journ. Micr. Science, April) describes in detail the eye and optic tract of the flesh fly (*Musca vomitoria*). The pseudo-cones he has found to be composed of four cells, with their nuclei situated internally, each one containing a large watery or albuminous vacuole, which serves the same purpose, and is morphologically homologous with the crystalline cone of the "eucone" eyes. There are six retinulæ cells, each possessing a nucleus situated in that part of it which lies immediately behind the pseudo-cones, and in some cases an additional nucleus, situated about half-way down. He has figured for the first time the interommatidial tracheal vesicles which have been previously observed by several investigators. In the optic tract he has described three ganglia—the opticon, epi-opticon and peri-opticon. The last of these is composed of a number of small cylindrical elements of a tissue composed of a sponge-work of nerve-fibrillæ, which he has called a "neurospongium." The opticon and epi-opticon are present in all insects, and in most of the higher Crustacea. The peri-opticon appears comparatively late in development, but is never found even in the adults of Periplaneta and Nepa.

The peri-opticon, when present, is usually composed of a number of cylindrical elements, which partially fuse in Æschna and

completely in Eristalis, Bombyx and the Crustacea. In Eristalis the peri-opticon is traversed by a number of delicate tracheal vessels.

The terminal optic anastomosis of Nepa is more complicated than it is in Periplaneta, and seems to be an intermediate stage between the simple anastomosis, the true peri-opticon of Musca.

A similar series of intermediate stages between the simple anastomosis and a true peri-opticon has been traced in the development of these parts in the bee.

The development and comparative anatomy of the peri-opticon of insects is interesting, as it may indicate the mode in which central ganglia were first formed from primitive nerve-fibrils and cells.

His investigations seem to him to corroborate the opinion of the majority of previous investigators, that the retinulæ are the true nerve-end cells.

How Insects adhere to flat vertical Surfaces.—Herr H. Dewitz gives an account of some further observations on this subject, tending to prove that the secretion by which, *e. g.*, flies adhere to window panes, is not a thin fluid of a fatty nature, but much more consistent. He adduces experiments to controvert Rombout's view that a fly can maintain itself on a glass surface by one leg only, if that surface be vertical and if the body of the fly be in contact with the glass.—*Journal Royal Microscopical Society, October, 1885.*

Season Dimorphism in Spiders.—The researches of Weismann into the phenomenon known as seasonal dimorphism among butterflies, are well known. Something of the same kind is stated by Dr. F. Dahl to occur in spiders. In an earlier communication this author had pointed out the fact that *Micrommeta virescens* and *M. ornata* were simply two broods of the same species. He now advances another instance in *Meta segmentata* and *M. menger*, stating his reasons for believing them to be respectively spring and summer broods of the same species.—*Journal Royal Microscopical Society, October, 1885.*

Entomological News.—In the twenty-eighth volume of the Annales de la Société Entomologique de Belgique, we notice descriptions of the metamorphosis of *Leptinotarsa undecimlineata* Stál and *Tropisternus lateralis* Fabr., by Dr. Eug. Dugès of Mexico. In the first part of Vol. xxix of the same Annales C. Van den Branden publishes a catalogue of the aquatic carnivorous beetles. The family Dytiscidæ numbered, according to the Munich catalogue, 893 species; to-day the present catalogue enumerates over 1500 species. C. Kerremans also enumerates the Buprestidæ described since the publication of Gemminger and Harold's catalogue.—In the Comptes-rendus of the same Society Mr. S. H. Scudder shows that the *Brachypyge carbonis*, described by Dr. H. Woodward as

the abdomen of a crab, is in reality the abdomen of an arachnid, of which six species are now known, one from the coal measures of Arkansas.——In A. Walter's article on the morphology of Lepidoptera in the Jenaische Zeitschrit for May, we have an account of the mouth-parts of Acentropus.——The transformations of *Paraponyx oryzalis*, an insect pest of the rice-plant in Burma, are described and well figured by J. Wood-Mason, in a pamphlet printed in Calcutta. Its larva is aquatic and breathes by tracheal gills. We wish the author had given more detailed sketches of the gills and their relation to the body.——We omitted to note Kowalevsky's contribution to the post-embryonal development of the Muscidæ in the Zoologischer Anzeiger for Feb. 23, 1885.

ZOOLOGY.

THE SIGNIFICANCE OF THE CELL NUCLEUS TO THE PROBLEM OF HEREDITY.—The results of the later researches upon fertilization and cell division, have tended to make biologists view the cell nucleus as of pre-eminent inportance for the life of the cell. In 1884, Kölliker, in his Entwickelungsgeschichte, stated, that since fertilization consists essentially in the fusion of a male with a female pronucleus into one segmentation nucleus which entails its hermaphrodite character upon its offspring of cell generations during ontogenetic development, this fact gives us the true reason why, and how every organism resembles its parents. The last two years have been fruitful in discussions of the problem of heredity in the light of nuclear investigations and have stimulated Kölliker to expand the above statement with more completeness and detail in the paper[1] of which this article is an abstract.

From our present knowledge of the biology of the cell nucleus we may draw certain conclusions of great value as a basis for the discussion of the problem of heredity, as follows:

The nucleus, and it alone, contains a substance which possesses the power of building up an organism according to specific characters, making it resemble the parents from whieh the nucleus originally came—in other words, possesses the hereditary power.

This follows from:

(*a*) *The nature of the spermatozoön:*

We know that but one spermatozoön is needed in the fertilization of one egg; we know that this must carry the hereditary traits of the father which he received from his ancestors both male and female; each spermatozoön is a nucleus.

Kölliker, in 1844, held the spermatozoön to be the equivalent of a cell, but later came to the conclusion that it represents a nucleus. Other biologists agreed with Kölliker so far as the *body* of the spermatozoön is concerned; but the *flagellum*, they said represents the cell protoplasm; and hence a spermatozoön may

[1] "Die Bedeutung der Zellenkerne für die Vorgänge der Vererbung." Zeitschrift für Wissenschaftliche Zoologie. Band XLII, erstes heft. July, 1885.

still be the equivalent of a cell. This may be true, for instance, says Kölliker, for trematodes; but he has shown that for the higher vertebrates the spermatozoa are, in toto, nuclei. It therefore follows that in the spermatozoa of lower animals the nucleus is the necessary fertilizing part, the flagellum serving merely as a locomotor organ, being later absorbed by the yolk. The pollen grains of phanerogams are also nuclei.

(*b*) *The phenomena of fertilization:*

Since Bütschli, in 1872 discovered the two pronuclei in the newly fertilized egg, the phenomena of nuclear conjugation have been carefully studied, especially by O. Hertwig, Fol, and Van Beneden. It is agreed that the male element penetrates the yolk and unites with a portion of the egg-nucleus; but in some important details there is disagreement. The most complete observations have been made on *Ascaris megalocephala* by Van Beneden and by Nussbaum. These observers agree that only the nucleus of the zoösperm forms the male pronucleus; though Van Beneden, even here, finds a "perinuclear zone" which takes no part in the fertilization. It is also agreed that before being fertilized, or conjugating with the male pronucleus, the egg-nucleus throws off a portion of itself in the polar globules, by a complex process resembling indirect cell division. In this process it is generally agreed that the nuclear figure is divided equatorially; but Van Beneden strongly insists that the division is meridional. He further thinks the germinal vesicle is not an ordinary cell nucleus because *all* the chromatin is in the nucleolus.

Minot, Balfour and Van Beneden think all cells are hermaphrodite; and that before conjugation can take place the male cell must lose its female nuclein, and the female cell its male nuclein which is passed over into the polar globules. But against such an hypothesis there are grave objections.

(1) It is known that in the processes of spermatogenesis in many animals, no part of the spermatogonia is lost. (2) Usually two polar globules are successively formed by the repeated halving of the egg nucleus. Now to get rid of the male nuclein this substance must be so distributed as to be separated by the plane of division from the remaining or female nuclein; and then, the male nuclein would be lost in the first globule and there would be no need of a second. (3) We know that the spermatozoön confers hereditary traits from both father and mother upon offspring; and likewise for the female pronucleus. Therefore we conclude, the *pronuclei are essentially in their nature hermaphrodite*.[1]

Kölliker plausibly suggests that the function of the polar globules is simply to reduce the size of the egg-nucleus comparable to that of the male pronucleus.

[1] This word, hermaphrodite, means simply, that hereditary powers from two lines of ancestry, indefinitely dichotomously compounded, are combined, and not what we popularly understand by the term.—*J. N.*

The general law of fertilization, stated by Strasburger for plants, and which we see from the above holds also for animals, is:

Fertilization consists essentially in the conjugation of male with female nuclei; these are ordinary cell nuclei; and the cytoplasm takes no part in the process.

It is therefore erroneous to speak in a general way of the cell protoplasm as carrying the hereditary powers. Of the many writers who have treated this subject, only three or four have given more definite statements. Nägeli calls that substance *idioplasm*, which controls or determines the specific characters of the cell, but does not limit it to the nucleus as does Kölliker and Born. Strasburger distinguishes between two sorts of idioplasm, that of the cell (cyto-idioplasm), and that of the nucleus (karyo-idioplasm).

In the nucleus exists a substance of definite morphological and chemical character, known as nuclein or *chromatin. With this substance the idioplasm must be conceived as connected.* (1) The chromatin of the male pronucleus unites with that of the female pronucleus to form the chromatic figure of the segmentation nucleus. According to Van Beneden there is no union, but the chromatin loops of the pronuclei remain separate so as to give the segmentation nucleus a double character, morphologically, one-half being distinctly male and the opposite, female; and this holds true of all its offspring. But Nussbaum found that before segmenting, the nucleus has a stage in which the chromatin forms a single filament. Furthermore Van Beneden's own figures do not seem to Kölliker, to support his view. (2) The processes of karyokinesis show how important it is that the chromatin should be divided between the daughter nuclei in a definite way. It is natural to suppose that to distribute the hermaphrodite idioplasm to the daughter cells, so that each shall get its proper amount, must be a delicate process.

We have now to inquire how the idioplasm effects the work of heredity.

In the development of an egg into an adult there are two moments at work. First, the cells multiply until a sufficient number of cells needed by the organ is produced; second, these cells are separated into groups and are differentiated into the various tissues. We may refer to the cambium zone of plants for a familiar illustration.

The structural characters of any organism depend on these factors: (1) cell *division*, and (2) cell *growth;* both as to (a) *quantity*, and (b) *quality.*

Cell multiplication, if great, will produce a large organ; if less, a smaller. The multiplication may be uniform or may be more rapid at certain points. Thus in the arm rudiment, five points of rapid cell division alternate with points of rest, and the five fingers are produced. Lastly, the cell division may take place in one,

two, or three planes, and give rise accordingly to very different aggregates.

As to cell growth, the size will depend directly on it; but like multiplication, growth may affect some cells and not others; again, like multiplication, cell growth may take place in one, two, or three dimensions.

We can now readily see that *the quantity and quality of cell multiplication and cell growth, according to a specific type of combination for the different organs and thus for the whole organism, builds up the individual with its specific characters.*

Now, the nucleus governs cell multiplication. (1) Division of the nucleus leads in cell division. (The author here shows that certain apparent exceptions are not really so.) (2) The position of the nuclear spindle determines the plane of division.

The *nucleus* also *governs cell growth.*

(1) Young and active cells have conspicuous nuclei, while cells that have done their work are without them. (2) The size of the nucleus increases as the cell increases (cf. Actinosphærium). The nucleus in large cells may separate into many parts so that every portion of protoplasm shall have a nucleus to preside in it. In protozoa these nuclei fuse again before division of the cell, while cases where the mass breaks up without this union are where the nuclei have become independent cells, viz: swarm spores. (3) Artificial division of Protozoa, shows that pieces without a nucleus do not grow. (4) Free cell formation may be considered as due to the fusion of minute nuclei (vid. Berthold, Mitth. der Zool. Stat. Neapel, ii, p. 78) and around the nucleus thus arising a cell is formed. (5) As several of Haeckel's innucleate monera have shown nuclei, when treated with appropriate reagents, Kölliker expects that all will do so when investigated by the methods of an advanced staining technique. (6) The activity of the nucleus is shown by the rays that stream from it in the protoplasm, and by the active manner in which it reacts towards stains.

From this we conclude, that the nucleus has great and controlling significance for the cell, being in active relation to the protoplasm.[1] Some authors have given it the function of manufacturing albumen, chlorophyll, etc. The structure of the cell, in fact its life history, is conceived to depend on the nucleus, whose *idioplasm has a minute structure of a definite type for each species;* and on this structure will depend the method of its work and how it shall react towards external influences. Modifying forces

[1] Pfitzner, in a recent paper (Zur Bedeutung des Zellkerns, Morph. Jahrbuch xi, 1, p. 54), calls the chromatin the "*ground substance of life.*" He also shows, by the application of a new method of staining, that the nucleoplasm or achromatin remains distinct from the cytoplasm during all the stages of karyokinesis; that many so-called multiple nuclei are separated portions of chromatin imbedded in a continuous matrix of achromatin; and that modern cytologists have generally applied the term *nucleus*, to only the chromatic portion, wholly ignoring the achromatic.—*J. N.*

to influence heredity must affect this structure and thus only, can produce variation.

We have finally to inquire, what are the changes which the idioplasm suffers during the ontogenetic development of an organism? *Each cell which results from the segmentation of the first embryo nucleus must be the equivalent, in all respects, of this nucleus, and, theoretically, capable of reproducing the individual.* Weismann has a theory opposed to this view. According to this author, only the very earliest cells produced in segmentation are set apart as germinal cells; all others have lost the power to be germinal cells, but must invariably differentiate into the organs of the body. Thus we really have no death, but only a series of germinal cells which gives off, by cell multiplication, from the fertilized egg, a mass of cells which differentiates into the individual. This aggregate alone is dissolved in the process known as death.

Kölliker cannot accept this theory. Every organ begins in a mass of embryonic cells, from which parts may be renewed if lost. Cells that have differentiated may, under proper circumstances, regain their germinal power. The buds that appear at various points of a mass of embryonic vegetable tissue, essentially reproduce the structure of the individual. In plants, the germinal cells can not be said to be set apart early in life. (Compare also adventitious buds.) Even in the adult animal organism, occur embryonic cells, such as osteoblasts and odontoblasts, the deep cells of the epidermis, cells of many glands, lymph cells, and germinal cells. The last are themselves, like other cells, differentiated in a particular direction, some forming eggs and some spermatozoa. All asexual reproduction, such as fission, budding, parthenogenesis, shows that other cells besides germinal cells, can reproduce the organism. It would be an interesting inquiry to ascertain what circumstances cause the cells to reproduce the whole body or only a part. It is not necessary to hold the early differentiation of germinal cells, nor to locate them for all animals in the same embryonic layer, since all cells are primarily germinal cells like the fertilized egg; and according to the function they are to serve in the adult, they differentiate into the appropriate tissues.—*F. Nelson.*

The Retrograde Metamorphosis of Siren.—I have already pointed out (Naturalist, 1885, p. 245) that palæontology shows that the Batrachian order of Trachystomata, which embraces the Sirenidæ, is a degenerate type, if the structure of its skull, limb-arches and limbs be considered. I have now reason to believe that there are indications of a retrograde metamorphosis to be found in the history of its branchial apparatus. I have been for a long time at a loss to account for the curious condition which I have frequently observed in the branchiæ of the Sirens. The

fringes are frequently in a state of apparent partial atrophy, and enclosed in a common dermal investment of the branchial ramus, or all the rami are covered by a common investment, so as to be absolutely functionless and immovable. This character, observed in the *Pseudobranchus striatus*, gave origin to its separation from the genus Siren. The character is, however, common to the *Siren lacertina* at a certain age, and the real difference between the genera depends on the different number of the digits in the two.

I have been more than ever surprised on discovering that the functionless condition of the branchiæ is universal in young individuals of *Siren lacertina* of five and six inches in length; and lately I have observed that in a specimen of a little over three inches they are entirely rudimentary and subepidermal. I have, in fact, noticed that it is only in large adult specimens that the branchiæ are fully developed in structure and function. The inference from the specimens certainly is that the branchiæ are in the Sirens, not a larval character, as in other perennibrachiate Batrachia, but a character of maturity. Of course, only direct observation can show whether Sirens have branchiæ on exclusion from the egg; but it is not probable that they differ so much from other members of their class as to be without them. Nevertheless, it is evident that the branchiæ soon become functionless, so that the animal is almost, if not exclusively, an air-breather, and that functional activity is not resumed till a more advanced age. That Sirens may be exclusively air breathers I have shown by observations on a specimen in an aquarium which for a time had no branchiæ at all. (See Journal Academy Phila., 1866, p. 98.)

In explanation of this fact it may be remarked that this atrophy cannot be accounted for on the supposition that it is seasonal and due to the drying up of the aquatic habitat of the Sirens. The countries they inhabit are humid, receiving the heaviest rainfall of our Eastern States, and there is no dry season. The only explanation appears to me to be that the present Sirens are the descendants of a terrestrial type of Batrachia which passed through a metamorphosis like other members of their class, but that more recently they have adopted a permanent aquatic life, and have resumed their branchiæ by reversion.—*E. D. Cope.*

Recent Additions to the Museum of Brown University.—Of late there has been made at this institution considerable effort to secure indigenous representatives of the animals which occur in the neighborhood of the college, and especially of such as are likely soon to be exterminated from the narrow bounds of Rhode Island, the most thickly settled State of the Union. Within a few weeks there has been secured a local representative of Blanding's box tortoise (*Emys meleagris*), an animal well deserving a position in the cabinet, as both an early describer, Dr. John E.

Holbrook, and the person to whom he dedicated the species, Dr. William Blanding, were graduates of this college. A representative of the musk turtle (*Aromochelys odoratus*) is interesting in that it is a giant of its species, the carapax measuring four and one-half inches in length. An otter (*Lutra canadensis*) is also worthy of note, as it is an animal extremely rare in this region. This specimen was shot on the island of Rhode Island, and was large and in excellent condition, a state of health somewhat different from that presented by an emaciated wild cat (*Lynx rufus*), captured in the more southern portion of the State, and probably the last Narragansett representative of its species.

Perhaps the most interesting acquisition is that of a hoary bat (*Atalapha cinereus*). This animal, a beautiful female, was found a few miles from Providence, on a pine tree which had been recently felled. Dr. C. Hart Merriam, in writing of this species, says: "From its almost boreal distribution, and extreme rarity in collections, the capture of a specimen of the hoary bat must, for some time to come, be regarded as an event worthy of congratulation and record. Although I have been fortunate enough to shoot fourteen, I would rather kill another to-day than slay a dozen deer."—*H. C. Bumpus.*

Zoological News.—*Echinoderms.*—Twenty species of Echini were, according to Mr. R. Rathbun, collected during the expedition of the *Albatross* in 1884. They include *Homolampas fragilis* and *Aceste bellidifera.* The latter species was only obtained by the *Challenger* in the vicinity of the Canaries, and was not found by the *Blake* in the Gulf of Mexico. The *Albatross* obtained it off the east coast of the United States, in 1497 fathoms.

Crustaceans.—S. J. Smith describes *Eunephrops bairdii,* n. gen. and sp., a relative of Homarus (Proc. U. S. Nat. Mus., 1885, 167). The writer compares the species throughout with *Nephrops norvegicus.* The genus agrees with Homarus in the number and arrangement of the branchiæ, with Nephrops and Homarus in possessing antennal scales and well-developed eyes; with Nephropsis in having very large antennal spines, and with Nephrops in its slender and carinated chelæ. One specimen, female, was dredged by the *Albatross* in the Gulf of Darien, 155 fathoms.—— The same naturalist also contributes a paper upon some genera and species of Penæidæ, mostly from recent dredgings of the United States Fish Commission. The new species are *Parapenæus megalops* and *goodei, Hymenopenæus robustus* and *modestus.*

Mollusks.—W. H. Dall contributes notes on some Floridian land and fresh-water shells, with a revision of the Auriculacea of the Eastern United States. *Hydrobia wetherbyi* and *Pupilla floridana* are described as new, also *Sayella crosseana* and *Onchidium floridanum.*

Fishes.—D. S. Jordan and S. E. Meek (Proc. U. S. Nat. Mus., April 20, 1885) give a list of fishes collected in Iowa and Missouri, with descriptions of the new species, *Notropis gilberti* and *Ammocrypta clara.*——S. Garman (l. c., April 23) describes as new *Mylobatis goodei*, from Central America; *Dasybatus kuhlii; D. varidens*, from Hong-kong; *Urolophus nebulosus*, from Colima, Mexico; *U. fuscus*, from Niphon; *Raja fusca*, also from Japan; *Raja senta*, from deep water off the coast of Massachusetts, and *R. jordani*, from San Francisco, California.——D. S. Jordan and S. E. Meek (Proc. U. S. Nat. Mus., 1885, 44) give the synonymy and an analytical key of the American species of Exocœtus. The authors admit seventeen species, fourteen of which they place in Exocœtus, while the remaining three are placed in three other sub-genera. Most of the species have a very wide range. *E. californicus* is probably the largest species. ——A study of the skulls and vertebræ of twenty species of Etheostomatinæ or darters, made by D. S. Jordan and Carl H. Eigenman, has induced the former to replace these little fishes in the Percidæ. "The Etheostomatinæ are near allies of the Percidæ, and should not form a separate family."——T. H. Bean (l. c. 73) describes *Plectromus crassiceps*, a single example of which was taken by the *Albatross* at the greatest depth explored, viz., 2949 fathoms, and three other examples at lesser depths. The same ichthyologist describes *Aspidophorides güntheri*, from Alaska.——A writer in the Bulletin of the U. S. Fish Commission states that he has been a witness to the destruction of just-hatched trout by mosquitoes. When a young fish came to the surface in the sunshine, a mosquito immediately transfixed its brain with its proboscis, and held on until the life juices were sucked away, when the dead trout floated down stream. The locality was the Gunnison valley, Col.——Mr. J. A. Ryder has contributed to the Proceedings (U. S. Nat. Mus., 1885), a most valuable paper upon the development of viviparous osseous fishes. He quotes the observations of Girard and Blake upon the Embiotocidæ of the Pacific coast, and adding observations of his own upon the gravid females of three species, arrives at the conclusion that: (1) the hypertrophied hind gut of embiotocid embryos, clothed internally with crowded villi of great length, has probably a digestive function, enabling the young fish to assimilate the nutriment contained in the abundant fluid given out by the walls of the ovarian sac; and (2) that the great development of the interradial membrane of all the vertical fins, and the abundance and size of the blood vessels which supply that membrane, are mainly for the purpose of effecting respiration through the skin. In the later stages of development the protruding hind gut commences to diminish in size. In *Gambusia patruelis* each egg and egg-sac has its own independent supply of blood from the mother's arterial system. The

male is scarcely one-sixth the weight of the female. There is no trace whatever in the egg follicles of Gambusia of an independent egg membrane. The developing young of Gambusia obtains no nutrition from its parent.——The same ichthyologist contributes a paper on certain features of the development of the salmon.——Dr. Bean describes *Stathmonotus hemphillii*, a small fish from Key West, Fla., related to Murænoides.

Batrachians.—O. P. Hay (Proc. U. S. Nat. Mus. 1885, p. 209), describes as new *Amblystoma copeianum*, from Indiana. It is without the yellow spots of *A. tigrinum*, has a lateral brown band, a broader and more depressed head, a more compressed tail, and longer limbs than *A. tigrinum*.——The brothers P. B. and C. F. Sarason show that the genus Epicrium is not viviparous, as is Cæcilia, but oviparous. In the most advanced stage before hatching, the embryo is provided with very long blood-red external gill-filaments, and has also a distinct tail with a strong fin. The gill-filaments are shed previous to hatching, after which the young Cæcilians make their way to the neighboring stream, in which they breathe by means of gill-slits. After they leave the water their gill-slits close up, and they breathe by lungs. There is a fourth gill-arch, from which the pulmonary artery is given off. The spermatozoön has a spiral filament. The last two facts tend to show that the Cæcilians are nearer to the Urodela than to the Anura.——It has been shown that the old species *Rana temporaria* contains many specific forms that have been confounded because of great resemblance in coloration and habits. M. G. A. Boulenger distinguishes eight species of red frogs or *Ranæ temporariæ*, viz., *R. fusca, arvalis, sylvatica, iberica, latastei, japonica, agilis, and pennsylvanica.* Exteriorly these forms differ in the greater or less length of the pelvic members, the shape of the head, the size of the tympanum, the greater or less development of the tubercle of the first cuneiform bone, the presence or absence of the vocal sacs in the male, etc. The vomerine teeth differ as do also the genital organs of the males. In the species with vocal sacs, or at least in *fusca* and *arvalis*, the throat of the males becomes blue in spring, and a bluish tint invades the skin. The arms of the males, always more robust than those of the females, become thicker still in the rutting period, and the thumb then becomes covered with rugosities. Copulation takes place at the end of winter or in early spring, when the males may be seen firmly seated on the females, with their arms around them and their hands joined over the breast. *R. sylvatica* and *R. pennsylvanica* are American, *R. japonica* is found in China and Japan and the others are European. *R. fusca* is found in most of Europe, except Southwest France and Spain; *R. arvalis* is found in the Northeast of Europe and probably in Northern Asia; *R. iberica* is limited to Spain and Portugal; *R. latastei* is found in Northern Italy, and *R. agilis* in

France, Switzerland and Northern Italy.——G. A. Boulenger calls attention, in the *Zoölogist* to the existence of two kinds of aquatic frogs in North Germany. Though included as sub-species of *R. esculenta*, they can be distinguished from each other at first sight, and breed at different times of the year. In the typical *R. esculenta*, the inner metatarsal tubercle is compressed and large, and the black marbling of the flanks and hinder side of the thighs encloses more or less of bright yellow; while in the larger variety, *R. fortis*, the inner metatarsal tubercle is small, elongate, and feebly prominent, and there is no yellow on flanks or thighs. The whole physiognomy is different and the fact that the larger kind breeds earlier keeps the breeds pure.

Reptiles—G. A. Boulenger describes *Agama doriæ*, a new lizard from Bogos in Northern Abyssinia. In proportions and characters of the scales it is similar to *A. colonorum*, between which and *A. bibronii* it is intermediate.——Dr. O. Boettger's list of the reptiles and Batrachia of Paraguay, comprises sixty-three species collected by H. Rohde, of which nineteen are lizards and twenty-four snakes. The new lacertilian genus Micrablepharus, is instituted for *M. glaucurus*, and other new species are *Amphisbæna albocingulata*, *Lepidosternum boulengeri*, *strauchi*, *affine* and *orycho-cephalum*, *Mabuia tetratænia*, *Liophis genimaculata*, *Rhinaspis rohdei*, *Leptognathus cisticeps*, and the batrachians *Engystoma albopunctatum* and *mulleri* and *Leptodactylus diptyx*.

Birds.—The collection of "Birds of the British Asian Empire," recently donated to the British Museum by Mr. O. O. Hume of Simla, contains 63,000 skins of birds, 300 nests, and 18,500 eggs. It contains about 2000 species, each represented by some thirty examples, mostly representing different stages of growth or degrees of variation. Mr. Hume has been the best authority on Indian ornithology, and intended to publish a work on the "Birds of the British Asian Empire," but other duties, and the loss by theft of his manuscripts, determined him to donate his collections to the British Museum, that they might be worked up by Mr. Sharpe.——R. Ridgway (Proc. U. S. Nat. Mus., April 20, 1885) describes a new more brightly colored variety of *Icterus cucullatus* from Yucatan; *Centopus pileatus* from some part of Tropical America; *Cyanocorax cucullatus* and a variety of *Vireolanius pulchellus* from Costa Rica, and *Certhiola finschi* and *C. sundevalli* from the Lesser Antilles. Mr. Ridgway also gives a key to the species of Certhiola (honey creepers) and gives the name of *Branta minima* to a very small form of barnacle goose which breeds in Western Alaska and migrates south to California in winter. *Onychotes* (*Buteo*) *gruberi* Ridgway, formerly thought to be a Californian bird, is now by its original describer, on the faith of a plate published in the report upon the birds of the *Challenger* Expedition, considered a synonym of *Buteo solitarius*, from the Sandwich islands. Mr.

Ridgway also describes *Cancroma zeledoni*, from Central America, and *Rupornis gracilis*, from Yucatan.——L. Steyneger describes (*l. c.*) a new species of tree-sparrow (*Passer saturatus*) from the Liu-kiu islands.——José C. Zeledon contributes to the Proc. U. S. Nat. Mus., a list of the birds of Costa Rica, 692 species in all.——L. M. Turner gives (*l. c.*, 233) a list of the birds of Labrador from Hudson strait to the Gulf of St. Lawrence, and west to 82° W. long., 764 species in all.

Mammals.—F. W. True (Proc. U. S. Nat. Mus., 1885, 95) describes as new *Phocæna dalli*, and reduces the previously described species of porpoise to three, viz: *P. communis*, *P. lineata*, and *P. spinipinnis*. In coloration, in the form of the head, and in the much larger number of vertebræ, *P. dalli* approximates Lagenorhynchus. A cordate area of white occupies the belly and lower half of the sides; the beak is shorter and the temporal fossæ smaller than in *P. communis;* the vertebræ are ninety-seven or ninety-eight in number, instead of sixty-six, as in *communis*, and the dorsal fin is concave on its posterior margin. The Aleuts, according to W. H. Dall, recognize this species as distinct from the smaller *P. vomerina* (= *communis?*).

EMBRYOLOGY.[1]

The Development and Structure of Microhydra ryderi Potts.—The discovery and prolonged observation in the living state of this remarkable fresh-water cœlenterate, which is obviously allied to Hydra, is due to the painstaking care of Mr. Edward Potts, who found it adherent to stones to which fresh-water Polyzoa were attached, which he brought from Tacony creek, near Philadelphia. Mr. Potts has named the animal for the writer,[2] to whom he has also turned over three series of sections, prepared by Mr. Harold Wingate, from three individuals. Fortunately two of these series of sections, one a slide containing forty-two transverse, and another nine longitudinal sections, enables me to make a very thorough comparison with the structure of Hydra as displayed in a series of sections of *H. viridis* and *H. fusca*, from both of which Microhydra differs not only in size but also in histological details as well as in its mode of development. This singular organism also differs widely from the marine *Protohydra leuckartii* Greef, in being very much smaller, and in being an inhabitant of fresh water; it also differs from Protohydra in its method of reproduction by gemmation from the side of the body instead of by transverse fission. In this last

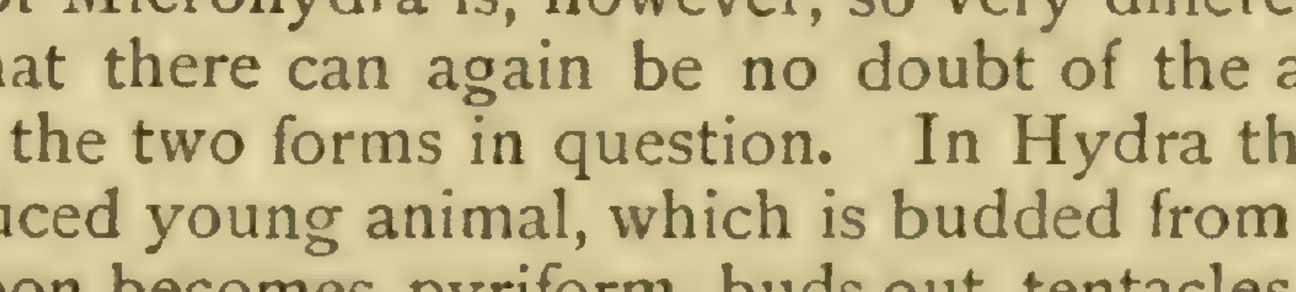
[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

[2] *Science*, Vol. v, 1885, No. 123, in the accompanying cover sheets, called the *Science Bulletin*, p. v, under the head of Recent Proceedings of Societies, the name *Microhydra ryderi* was first published, together with a brief account of its structure and habits, as a report of a verbal communication made by Mr. Potts at the meeting of the Academy of Natural Sciences of Philadelphia, held May 19, 1885.

feature, or in respect to its gemmiparous development, Protohydra agrees with the Acraspeda or Discophora, in multiplying by transverse fission, such as is seen in the asexual Strobila stage of the latter. In one important feature Protohydra and Microhydra agree, namely, in that neither form possesses the slightest traces of tentacles. The widely different habitats of the two forms, as well as their diametrically opposite methods of gemmiparous reproduction, leads me to the conclusion that they are not very closely related. Its affinities are clearly with Hydra, but that it cannot in any sense be regarded as a mere stage of the development of the latter, follows from other considerations which I will now state.

Its minuteness might very readily lead to its being overlooked. It measures alive .5^{mm} in height; the longitudinal sections in my possession are somewhat shorter, or about .475^{mm} in length, a difference probably due to contraction. Its diameter at the oral end is somewhat greater than at the base, and ranges from about .15 to .175$^{mm.}$ In fractions of inches its dimensions are: height $\frac{1}{60}$ inch, diameter of body $\frac{1}{160}$ inch, constituting it the most diminutive adult hydroid or cœlenterate type yet known, so that its generic name is especially appropriate. In life the animal is very much less contractile than Hydra, and is without the well-defined pedal disk of the latter or of Protohydra.

No sexually mature individuals of Microhydra have been found by Mr. Potts, who has, however, most laboriously and carefully studied the gemmiparous or asexual reproduction of the species in the living animal, he having been able, in fact, to watch this process in several successive generations. The asexual reproduction of Microhydra is, however, so very different from that of Hydra that there can again be no doubt of the absolute distinctness of the two forms in question. In Hydra the gemmiparously produced young animal, which is budded from the sides of the body, soon becomes pyriform, buds out tentacles and is constricted off from the parent by transverse fission around its base or pedal disk. In Microhydra a very different method of lateral gemmation occurs, since the bud very soon becomes sausage-shaped instead of pyriform, but it grows out from a swelling or thickening at the side of the parent the same as in Hydra. In Microhydra a constriction or furrow appears at either end of the young bud as soon as it is well defined as such. The gradual



Microhydra ryderi.

progress of the development of a bud is shown in Figs. *a*, *b*, *c*, *d*, *e*, *f* and *g*. The last shows the young Microhydra in the act

of being detached from the parent. These figures are from sketches by Mr. Potts as the process was watched by him at different stages. It is clear from these figures that the process of gemmation in Microhydra is very different from that seen in other hydroids; it is, in fact, as if both ends of the young polyp were being budded out of the side of the parent simultaneously, final separation of the bud occurring at one of its sides instead of at its base. The process thus actually makes something of an approach toward longitudinal instead of transverse fission.

The bud after detachment drops down upon an adjacent surface and for a time lies quite prone upon its side. It is entirely without cilia, in this respect resembling the larvæ of Hydra. It, however, seems possessed of slight powers of locomotion, which is effected probably by the contractions of the body. After lying in its prone position for a time, the vermiform body of the polype becomes fixed to the foreign object upon which it rests, by one end, while the other end is slowly raised into the erect position, when it may be said that the creature is adult. The history of the internal changes which the larva undergoes while budding are not known, but it is probable that the bud has the oral opening developed at its free end by the time it assumes the erect position.

Colonies of two have been observed by Mr. Potts, appearing somewhat as in the sketch in Fig. *h*. This indicates that Microhydra in common with all other Cœlenterata has a tendency to form compound individuals or corms. Whether the stomachs of such compound individuals open into one another has not been ascertained, but it is extremely probable that they do. The preceding evidence, taken as a whole, it seems to me, leaves absolutely no doubt respecting the distinctness of the remarkable little organism discovered and so patiently studied by Mr. Potts.

The structure of the body in the Hydra and Protohydra agree pretty closely; in both there is an outer ectodermal layer, throughout which the nematocysts are pretty uniformly distributed. Under the ectoderm of both there is a thin layer consisting of contractile processes of the ectodermal cells. The endoderm consists in both of large vacuolated cells, containing excentrically placed nuclei and great numbers of granules at their inner ends. These large vacuolated, endodermic cells seem to line the whole internal cavity in both of the genera named.

In Microhydra the structure of the body is different from either of the preceding. There is a thin outer ectodermal layer, but the nematocysts are mainly aggregated at the oral end of the creature, few being present on the sides. Under the ectoderm there is a barely discernible thin stratum consisting very probably of the contractile processes of the outer layer cells. Around and just within the lips of the oral aperture the endodermic cells are solid. Just below the oral opening and for about one-third the

length of the animal, the endodermic cells are large and vacuolated as in Hydra, but the excentrically placed nuclei are absolutely and relatively very much smaller than in Hydra. There is a gastric cavity extending down from the mouth for about the same distance, below which the alimentary cavity becomes less apparent and is surrounded by solid endodermic cells. These details are shown in both the longitudinal and transverse sections. In the cross-sections evidences of slight irregular foldings of the endoderm are present as in Hydra.

Greef has described a homogeneous cuticula covering the basal part of the ectoderm of Protohydra. A similar homogeneous cuticula seems to loosely invest the ectoderm in the sections of Microhydra. Mr. Potts, however, is not disposed to agree with me on this point, as he informs me by letter that he was unable to detect any such envelope in the living larvæ studied by him.

There is a distinct but small oral opening at the upper end of Microhydra, which is cleft-like or irregular, through which food is taken in, as observed by Mr. Potts. The gastric cavity is small and only the upper end of it appears to possess a specially developed digestive function. The digestive cavity of Microhydra is, in fact, but little more developed than in the later planula-stage of such a form as Eucope. In fact, if the planula of the latter were to lose its cilia, become fixed and acquire a mouth, the morphological complexity of Microhydra would be realized. We have then in Microhydra an adult type which represents practically a planula which has acquired a mouth. In other words, the new type is not only the simplest of Hydroids, but is also the simplest of all true polypes or Cœlenterata. It is, in fact, a much more rudimentary form than even Protohydra, and represents perfectly a permanent gastrula which reproduces itself by lateral gemmation instead of by transverse fission.

It has been contended by some that Hydra is a degenerate form, and that Protohydra and Microhydra must be considered in the same light. As no very cogent reasons have ever been adduced in support of such a conclusion, I shall leave the *onus probandi* to be produced in favor of that view by those with whom it originated. The very simplicity of the type in question, it seems to me, must ever remain a serious bar to arriving at any very certain conclusions on this head. It seems as impossible to me to prove that Microhydra has been developed by the degeneration of a higher type, as it does to prove that it is a form which has advanced but very little beyond the planula stage of the Cœlenterata. The latter view seems to me to be by far the most probable, since it is a free-living form, which is no more likely to have been adversely affected than would hundreds of others living in the same environment. The significance of this singularly interesting type in relation to the question of the possible origin of the Cœlenterata is very great, and the interest which attaches to

it from the standpoint of the embryologist, it seems to me, fully warrants its discussion in this department.

With the help of Mr. Potts, who has generously given me permission to do so, I propose at an early date to prepare a more extended paper on this organism, with good illustrations. As it is, I must express my great obligations to its discoverer for the free use of many of the facts detailed above.—*John A. Ryder.*

[As this note on Microhydra goes to press, I have met with a paper[1], published in the Proceedings Royal Society, London, Vol. XXXVIII, No. 235, Dec. 11th, 1884, pp. 9–14. According to this account, the supposed hydroid phase of Limnocodium is without tentacles; it was found attached to roots of Pontederia in the tanks of the Royal Botanic Society, Regent's park. The figures given by Bourne of the suspected hydroid phase of the singular fresh-water Medusa known as Limnocodium, are certainly very similar to Microhydra, but the former is larger than the latter and measures from $\frac{1}{50}$th to $\frac{1}{8}$th of an inch long. Colonies of three or four individual zoöids were frequently met with. No true perisarc or cuticula was observed as in Microhydra, but the surface is covered with particles of mud and other *débris*, which becomes glued together by some secretion of the animal, and forms a sort of tubular casing. In internal structure this hydroid stage of Limnocodium differs considerably from Microhydra, however, judging from Bourne's description and figures. Is it possible after all that Microhydra is only the hydriform stage of fresh-water Medusa? If so, it is very probable that it may be allied to Limnocodium, the latter of South American origin, has in all probability a very different life-history from the North American Microhydra, if we may go so far as to assume that the latter has a medusiform adult stage. No lateral budding and dehiscence has been observed to occur in the supposed hydroid phase of Limnocodium, such as takes place in Microhydra, besides the larger zoöids of the former were over six times as long as those of the latter, otherwise there are many striking similarities. Notwithstanding the existence of these resemblances, I think we may assume that if Microhydra should turn out to be only the hydroid stage of a mature medusa-form the latter will be found to be generically distinct from Limnocodium, in which case it might be called Pottsia.—*J. A. R.*]

PHYSIOLOGY.[2]

RECENT BELIEFS CONCERNING CELL-STRUCTURE.[3]—Probably no branch of biology has been so richly developed during the last five years as that which concerns the intimate physical and chemical

[1] On the Occurrence of a hydroid phase of *Limnocodium sowerbii* Allman and Lankester, by Alfred Gibbs Bourne.

[2] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

[3] *La Biologie Cellulaire*, par le Chanoine J. B. Carnoy, Lierre, 1884.

structure of living cells. In 1665, fifty years after the invention of the microscope, Robert Hooke found that plants were made up of minute "cells and pores." For more than a century after, cells were regarded as tiny vesicles filled with an homogeneous fluid; then, in 1781, Fontana, discovered the cell-nucleus. In 1836, just about the time when the great generalization of the cell doctrine was receiving its first impulse, Valentin described the nucleolus. The work of Carnoy is an interesting account of all that the most refined methods of investigation have been able to discover in the morphology and chemistry of the cell. Carnoy's description is so minute, and goes so much beyond the statements of some of the most trustworthy observers, that the careful reader who has not repeated his demonstrations is apt to view it with suspicion.

But, judged by internal evidence, the work has been performed with skill and conscience; the author describes minutely his methods and the nature of the material employed, relying chiefly upon the examination of fresh tissues. The illustrations are all new and uncommonly well executed, but the reader has a right to complain at the complete omission of an index to the contents of the book.

In 1859 Stilling discovered a fibrillar structure in ganglionic cells, and in 1864 Leydig described a similar appearance in the intestinal cells of certain small crustaceans. In 1865 Frommann announced that the fibrillar structure was a general character of living cells and in 1873 Heitzmann arrived at the same conclusion. The existence of fibrils in the cell may be considered established as a general property of living tissue, but authors are by no means agreed as to the distribution and character of the fibrillar structure. Carnoy considers that all cell structure has been gradually differentiated from original formless, homogeneous protoplasm; the typical cell, however, is a very complex apparatus. Taking as an example an epithelium cell from the intestine of the wood-louse, Carnoy describes the cell as composed of hyaline protoplasm inclosed in a membrane, and including a greater or less number of granules. Imbedded in the protoplasm is a nucleus with a membrane of its own.

The cell protoplasm is not homogeneous but is traversed in all directions by a dense reticulum of fibrils, which is attached to the membrane of the nucleus on one hand and to the cell wall on the other. The nucleus exists like a small cell within the substance of the larger. But in the nucleus the fibrillar structure is two-fold in nature. The most evident of these is a convoluted filament of very striking presence and complex internal structure. It stains deeply with coloring reagents, dissolves in dilute alkalies and in strong acids; it forms a gelatinous mass with sodium chloride ten per cent, but dilute acids have no effect upon it; it is not digested by artificial gastric juice, but with iodine, and with Millon's

reagent it acts like an albuminoid. This filament appears to have the chemical characters of nuclein; it is identical with the chromatin of Flemming, and is the structure which takes so characteristic a share in the process of cell division. Carnoy insists, in contradiction of Flemming, that the nuclein or chromatin substance is not characteristically in the form of a net-work, but consists of a single complexly convoluted fibril. The filament may occasionally form a true reticulum, but this is an unimportant modification of the typical single thread structure. The nuclein filament may alter and undergo a retrograde metamorphosis with age, and in cases completely disappear; in this process the filament breaks up into irregular pieces which may be gradually absorbed. The presence of the nuclein filament is the only thing which distinguishes the nucleus either chemically or structurally from the rest of the cell. After solution of the nuclein or chromatin filament, a second structure is discovered in the nucleus, namely, a fine reticulum which has all the characters of that previously described as existing in the extra-nuclear protoplasm. In his later work, Flemming is said also to have admitted the existence of this intra-nuclear net-work. The wall of the nucleus is imperforate and, in contradistinction to Klein, there is no direct union between the nuclear and extra-nuclear reticulum of fibrils. The reticula are much more resistant towards solvents than are most albuminous substances. The fibrils of the nucleus are insoluble in water, alcohol and ether; in sodium chloride ten per cent, in dilute acids and, at a low temperature, in strong acids and alkalies; the reticulum is not digested by artificial gastric juice. The formless protoplasm in the meshes of the net-work contains much water holding albuminoids in solution and granules of various kinds in suspension. The author believes that all the reticular substance of the cell is especially endowed with the properties of irritability and contractility, while the more fluid protoplasm within its meshes is the seat of the general chemical changes of the cell.

The cell-wall is differentiated from the protoplasm by a series of very gradual changes. The outermost layer of protoplasm takes on modified physiological characters. While still living and contractile it becomes much the most resistant part of the cell toward reagents, even more so than the substance of the reticulum itself. The membrane, like the cell matter, is made up of a close reticulum of fibrils whose interstices are filled by a more fluid substance. By a series of insensible gradations the protoplasmic membrane may be differentiated into a rigid, inert cell envelope. The various markings which are so striking a feature in the walls of many cells, both animal and vegetable, probably owe their foundation to this complicated structure of the original living cell-membrane.

Nucleoli of two distinct kinds have been confused together by

authors. The first of these consists merely of detached pieces of the nuclein or chromatin filament. The second kind of nucleolus is only a nucleus in miniature, and is quite independent (Strasburger to the contrary) of the chromatin filament. This nucleolus is a reserve fund for the use of the nuclear protoplasm and true nucleoli disappear during the process of cell-division. The membranes of cell and of nucleus are identical in their general characters.

The peculiar parallel streaks which are found connecting the two rosettes of chromatin substance after these have separated during cell-division, Carnoy declares to be formed by the fibrils of the reticula found in the membrane and protoplasm of the mother nucleus, the parallelism being caused when the mother nucleus pulls itself apart. After complete formation of the daughter nuclei, the parallel fibrils become again transformed into the protoplasmic reticulum of the new cells. A rather full list of references to work on this subject may be obtained by consulting Carnoy, *op. cit.;* Flemming, Virchow's Archiv, 1879, Bd. 77, p. 1; Arnold, same volume, p. 181. The English reader may find a good general review of the subject in *Quart. Journ. Mic. Sci.*, 1882, p. 35.

THE PHYSIOLOGICAL CHEMISTRY OF THE KIDNEY.—It has been made almost certain by the various labors of Ludwig, of Heidenhain and of Nussbaum, that the kidney tubules where lined by cells containing considerable protoplasm are differentiated in their function from the thin walled Malpighian capsules at the extremities of the tubules. The commonly received opinion is that the wall of the capsule serves simply as a diffusion and filtration membrane through which pass water and inorganic salts which make up the bulk of the urine; while the large-bodied cells of the tubules, particularly of the convoluted portions, may be looked on as true secretory mechanisms which have the power of actively selecting certain substances, as urea and urates, from the lymph, and probably also of manufacturing specific products. Dr. Dreser comes forward to extend the evidences for a differentiation of function between the two parts of the secretory mechanism of the kidney. Dreser, experimenting on frogs, thinks he has shown that the fluid passed through the capsules of the kidney is *alkaline*, while that secreted by the convoluted portions of the tubules is *acid* in reaction.

The results of the work depended upon the peculiar behavior of "acid fuchsin" toward alkalies and acids respectively; the former render it colorless, while the latter restore its red tint. A five per cent to ten per cent so lution of acid fuchsin is injected into the lymph sac of a frog and in half an hour the urine, drawn by a catheter, is distinctly red. If sufficient material be injected the red tint of the fluid becomes less deep, but still is immediately

intensified by the addition of acid; this indicates that the kidney still secretes the injected fuchsin, but that its power of forming acid is diminished, probably due to fatigue of the secretory protoplasm. The kidney, examined microscopically early in the experiment, offers nothing peculiar in its appearance, all parts are equally colorless; but when fuchsin has been continuously eliminated during some hours the cells of the convoluted portions of the tubules are found stained deeply red, while the capsules are quite without color.

Heidenhain found in his researches on the elimination of indigo-carmine by the kidney that the nuclei of the cells were always deeply stained; but Dreser could, in his experiments, scarcely ever make out a reddening of the nuclei, though the cells were often so deeply stained that their outlines were indistinguishable. The author's lengthy discussion of the chemical-physiological bearings of his results cannot be given here.—*Zeitsch. f. Biol., Bd. xxi, p. 41.*

A Valuable Series of Physiological Journals.—The library of the University of Michigan has recently been enriched by the addition of a series of German journals of anatomy and physiology which represents the current progress of those sciences almost continuously from 1796 up to the present time. Reil's Archiv f. d. Physiologie was first published in 1796 and continued until 1815. Meckel's Archiv f. d. Physiologie extended from 1815 to 1823, and was succeeded in 1826 by Meckel's Archiv f. Anat. u. Physiol., which was given up in 1832. Müller's Archiv f. Anat. Physiol. u. Wiss. Med., continued from 1834 till 1858, and was succeeded by Reichert and DuBois Reymond's Archiv f. Anat. Physiol. u. Wiss. Med., which was published from 1859 till 1876. This in turn was succeeded in 1876 by the Archiv f. Anat. u. Physiol., at present edited by Professor DuBois Reymond. No physiologist can contemplate this splendid series of works without thoughtful and affectionate interest, for it forms the log-book of the progress of modern physiology. Reil, in the opening pages of his first volume written in 1795, strikes the key-note of modern physiological research, and some of his words seem like a prophecy which the history of ninety years has fulfilled. Says he, "It is indeed remarkable that physiology, if I exclude anatomy from it, has made relatively less progress than almost any other science and is, for the most part, but a waste of unfounded or senseless hypotheses. * * * * We seek the explanation of the phenomena of animal life in a supersensuous substratum, in a soul, in an universal spirit of nature, in a principle of vitality, which we picture as something uncorporeal, and we are thereby either hampered in our investigation or actually led astray. * * * * We must no longer regard the animal body as something of wholly mysterious and unthinkable prop-

erties, but, if we except the mental side, as a merely physical object included in the category of natural bodies; an object which is subject to the same laws of nature as are wood and iron, but which, nevertheless, like wood and iron, has its own peculiar qualities."

THE HISTOLOGY OF STRIPED MUSCLE-FIBER.—Mr. B. Melland makes an important contribution to the literature treating of the structure of muscular tissue. His view is a confirmation and extension of that long since announced by Schäfer (Quain's Anatomy, 2d vol.). The following is a summary of the author's main results: "There is an intra-cellular net-work present in the muscle-fiber of Dytiscus, the bee, frog, lobster, crayfish and rat, which may be most clearly demonstrated by certain methods of gold staining. The net-work alone is stained by the reduced gold, and, owing to this differentiation, is plainly visible with comparatively low powers. This net-work may be demonstrated, though not so completely, in the living fiber, and in acetic and osmic acid preparations. Crossing the fiber transversely, united to the sarcolemma, and more or less separating the muscle-fiber into compartments, are net-work partitions—the transverse net-works. Running longitudinally down each compartment, and joining the dots at the intersections of the fibers of the transverse net-work, are a series of fine rods. This net-work consists of an isotropous material, and is more highly refractile than the rest of the muscle substance, which is anisotropous. This net-work serves to explain the transverse striation and other complicated appearances presented by the muscle-fiber, and brings into harmony many of the conflicting statements of histologists on this subject."—*Quart. Journ. Mic. Sci., 1885, p. 371.*

PSYCHOLOGY.

INTELLIGENCE OF THE ELEPHANT.—In his interesting Two Years in the Jungle, Mr. Hornaday, gives us these impressions of the intelligence of the elephant:

The elephant is the most patient and obedient of all animals, and by far the most intelligent. He has more ability to reason from cause to effect than most other animals of docile temperament, and he is, beyond all question, the most capable of being taught, and the most willing to obey after he has been taught. To me it is a matter of surprise that Mr. Sanderson, who has, I presume, more personal knowledge of the animal, both tame and wild, than any European living, should place so low an estimate upon his mind. He declares that "its sagacity is of a very mediocre description," and also that "its reasoning faculties are far below those of the dog, and possibly other animals."

From this view, which I think is due to the fact that "familiarity breeds contempt," I differ very widely. My acquaintance with tame elephants has created in my mind a respect for their

intellectual qualities which I never could have acquired in any other way. A trained dog or horse is such a rarity, even among the thousands of their species, that it is considered a proper object to exhibit at a circus. A horse which will promptly back at the word of command, or a dog that will bark or stand on its hind legs when told to do so, is considered quite accomplished; but in India any well-trained elephant, at a word or touch from his driver, who sits astride his neck, will "hand up," "kneel," "speak" (trumpet), "salaam" (salute with his trunk), stop, back, lie down, pull down an obstructing branch, gather fodder and "hand up" to his attendant, turn or lift a log, or drag it by taking its drag-rope between its teeth. He will also protect his attendants, or attack a common enemy with fury. I think I am safe in asserting that there are in India to-day scores of captive elephants who are capable of performing all the services enumerated above; but of course there are many which are not so intelligent.

Contrast with this the performances of our most intelligent breed of dogs, the pointer. Even when young and trained under the most favorable circumstances, they are at best but capable of being taught only a few things, as to "go on," to "charge," to go in a given direction, and retrieve. The extreme difficulty of teaching a dog anything after he has passed his puppyhood is so universally acknowledged as to have given rise to the familiar proverb, "It is hard to teach an old dog new tricks." What a strong contrast is seen in the wild "koomeriah" elephant, caught when he was about sixty years old (by Mr. Sanderson), who "was easily managed a few days after his capture." Of all animals in the world what other would have so quickly learned that mind is superior to matter, that man is master of the dumb brute, or would have succumbed so gracefully to the inevitable?

INTELLIGENCE OF THE ORANG.—We will not say anything about the place the orang has in the long chain of evolution; but while abstract argument leads hither and thither, according as this or that writer is most ably gifted for the same, there is still one argument or influence to which every true naturalist is amenable and which no one will ignore who has studied from nature any group of typical forms. Let such an one (if, indeed, one exists to-day), who is prejudiced against the Darwinian views, go to Borneo. Let him there watch from day to day this strangely human form in all its various phases of existence. Let him see the orang climb, walk, build its nest, eat, drink and fight like a human rough. Let him see the female suckle her young and carry it astride her hip precisely as do the coolie women of Hindostan. Let him witness their human-like emotions of affection, satisfaction, pain and rage—let him see all this, and then he may feel how much more potent has been this lesson than all he has read in pages of abstract ratiocination.—*Hornaday's Two Years in the Jungle.*

ANTHROPOLOGY.[1]

DR. RAU'S PREHISTORIC FISHING.—No. 509 of the Smithsonian Contributions to Knowledge, is entitled "Prehistoric Fishing in Europe and North America." By Charles Rau. Washington: Published by the Smithsonian Institution. 342 p., 405 ills., 4to. This is an attempt at constructive anthropology. The author has sedulously examined archæological literature for accounts and illustrations of discoveries bearing on the fisherman's art. Placing these objects side by side with similar modern forms whose uses are known, the author has been able successfully to bring before us in his true attitudes the ancient artisans of the class under consideration. Access to the immense collections of the National Museum, and familiarity with the staff of the United States Fish Commission during many years, as well as the coöperation of archæologists at home and abroad, have strengthened Dr. Rau for his work and enabled him to prepare a monograph upon prehistoric fishing which will remain the standard authority upon that subject.

The volume is divided into two parts, that relating to Europe, 112 pages, and that relating to America, 224 pages. In the account of European fishery the chronological order is followed. Discarding the Tertiary, Dr. Rau discusses the implements of the drift, caves and rock-shelters, shell-deposits, lake-dwellings and bronze age which may have been associated with fishing. In the account of American fishing a different plan is pursued, each genus or species of apparatus related to fishing receiving attention in the following order: Fishing implements, utensils, boats and appurtenances, prehistoric structures connected with fishing, representations of fishes, aquatic mammals, etc., artificial shell-deposits. This portion closes with a large number of extracts from the old writers upon aboriginal fishing in North America, and an appendix on prehistoric fishing in South America.

There are many classific concepts according to which the anthropological objects in a museum may be arranged and their significance discussed, and each one of these is of great importance. Principal among them are race, nation, material, geographic distribution, chronology, evolution, structure and craft or function. These concepts are not antagonistic, but mutually supplementary, the only question in the curator's mind being which of them to place first, and in what order the others shall be placed. In the archæological department of the National Museum Dr. Rau places the concept *structure* at the head of the list. By all odds this is the best for archæological materials, because it not only enables the curator to have a sure place for every object, but it enables him or the student visitor to take up each craft exhaustively. There is no doubt that the immense

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

treasures under Dr. Rau's charge will enable him, now that the material is arranged, to give many more contributions as interesting as "Prehistoric Fishing."

A New Cranial Race Character.—Dr. Lissauer, of Dantzig, has recently published an important work with the following title: Untersuchungen über die sagittale Krümmung des Schädels bei den Anthropoiden und den verschiedenen Menschenrassen. Von Dr. Lissauer in Dantzig. Mit sieben lithographirten Tafeln. Separat-Abdruck aus dem "Archiv für Anthropologie." xv Band, Supplement. Braunschweig, 1885. pp. 112.

The author of this treatise introduces his subject with these words: "By sawing a skull through the sagittal median plane, and drawing, as exactly as possible, the outer contour of the section thus obtained, we get the sagittal aspect of the skull, the *norma sagittalis*. It presents a very irregular curve." * * * "A careful study of this curve in the different skull-forms of anthropoids and man will therefore be the object of this treatise."

Although, for the purpose of definition, the author speaks of sawing the skulls, in practice he does not consider it necessary; but describes an ingenious apparatus by means of which the sagittal curve may be traced without injury to the skull. His promise of a "careful study" has been well fulfilled. Every point of importance seems to have been thoroughly considered and clearly set forth. Dr. Lissauer has been obliged to invent a number of new terms, and as these will, no doubt, take a permanent place in the nomenclature of craniometry, it is fortunate that they are terms well devised.—*W. Matthews.*

Ethnology of Ancient Italy.—The ethnology and history of the populations of ancient Italy present problems of high interest, but these are just as perplexing through their intricacy as they are insolvable through the remoteness of the periods. Recent archæological finds have added new problems, but on the other hand have helped in clearing up doubtful points. Dr. Fligier, in his "Urzeit von Hellas und Italien,"[1] has given very strong reasons for supposing that the Japygians and Ausonians, as well as other aborigines of Middle Italy who passed for Pelasgians among the Romans, were, in fact, of the same race and stock as the Illyrians of antiquity and of the Pelasgians of Greece, and that a remnant of these and their language has survived up to our period in the Albanians or Shkipetars. Every year presents us with new researches on the subject. . Some of these mainly rest upon the testimony of the ancient authors, which are often conflicting and in many cases legendary and absurd, while others try to combine all the dates afforded by archæology, history, ethnology and linguistic science, to reach trustworthy results. This was the method followed by

[1] Archiv für Anthropologie, Band 13, Heft 4 (Braunschweig, 1881).

Dr. Fligier and by Baron Charles von Czœrnig, a high functionary of the Austrian government, who in a recent octavo volume of 311 pages has published his researches upon Upper Italian nations of ancient, mediæval and modern times. The people of the Euganeans, whose name is preserved in the territorial names of *Valsugana* (Vallis Fuganea) and Palugana, the author considers to have been Ræto-Etruskans, though he treats of them separately. In the momentous question, whether the Etruskans spoke an Aryan or a non-Aryan language, he prefers to await developments than to give a definite opinion, but considers the Ræti as a people originally identical with the Etruskans. They remained in the Alpine mountains, while the latter moved south into the plains of the Po river and settled there after subjugating the aboriginal people called Umbri. The Venetians, or Henetoi, a comparatively pure-blooded race, seem to have been Thracians, and the ancient authors almost unanimously proclaim their descent from Paphlagonia. The Celtic origin of some local names is distinctly traceable, on the western part of the Lombardic plain especially (p. 219). The sketchy biographies given of mediæval princes in Lombardy are very spicy bits of reading, and give us very graphic ideas of the arbitrary and cruel despotism in those dark ages. A short aperçu of the country's condition during the Napoleonic and recent period, mainly based on statistics, concludes the volume.—*Alb. S. Gatschet.*

Geographical Names in Mexico.—Antonio Penafeil, superintendent of the department of statistics in the Mexican Republic, has published in Mexico an alphabetical catalogue of the places in Mexico whose names are related to the Nahuatl language. In the catalogue of municipalities are many names so mutilated in orthography that it is difficult to recognize their origin and signification. Signor Penafeil has undertaken to reconstruct this nomenclature, forming an alphabetic index of American names of places existing in the latest part of the empire of Montezuma II, drawing his information from historic documents and from the hieroglyphic writings of the Nahuas, which are rightly considered to be the purest fountain of the ancient history of the Mexicans. Each word in this quarto volume of 220 pages is accompanied with the hieroglyphic symbol of the place, and with its equivalent in old and in modern Mexico.

The Kansas City Review.—This standard periodical, whose death was prematurely announced in the Naturalist, has put on a new dress and appeared in its ninth volume as number one of a new series. The editorial chiefs will be Dr. Theo. S. Case and Mr. Warren Watson. It is with sincere pleasure that we recall our obituary and give notice of the reörganization of the *Review*, with a shorter title and a brighter face.

MICROSCOPY.[1]

THE ALIMENTARY CANAL OF THE CRUSTACEA.—1. *Hardening.*—For the river cray fish, Frenzel[2] recommends Kleinenberg's picro-sulphuric acid diluted with only two times its volume of water. The preparation is left fifteen minutes in the fluid, then treated with the usual grades of alcohol. Osmic acid and the various chromic solutions proved worthless. Perenyi's fluid caused a slight swelling, but was of some service in the study of the liver and the nuclei of the middle gut. Corrosive sublimate (saturated aqueous solution) proved an excellent means of isolating the epithelium of the middle gut in the lobster. In preparations hardened in this fluid the epithelium becomes loosened from the wall of the canal, so that it can be stripped off in sheets and prepared for surface examination.

2. *Imbedding.*—Paraffine is preferred to celloidin. Precaution should always be taken to prevent the formation of large crystals, which not only render the paraffine brittle, but also injure the finer structure of the preparation, by immersing it in cold water and cutting soon afterward. If the paraffine block is allowed to stand for weeks crystallization sets in.

3. *Staining.*—The sections are fixed on the slide with chrome mucilage, then stained with alum carmine, alcohol carmine (Grenacher), aqueous hæmatoxylin (Böhmer) and safranin. For the epithelium of the middle gut a double stain with acid carmine and hæmatoxylin offers some advantages.

FRENZEL'S CHROME MUCILAGE AS A FIXATIVE.[3]—Make a thin solution of gum arabic in water and add to this an aqueous solution of chrome alum. An excess of the latter does no harm. A little glycerine is added to the mixture to prevent it from drying too rapidly when painted on the slide.

After painting the slide with a small brush the sections are placed in order and the slide left for a few minutes (not over fifteen minutes) in the oven of a water-bath kept at 30–45° C. The gum is thus rendered insoluble. The paraffine is next removed in the ordinary way and the sections stained according to desire. Fuchsin and safranin are the only analine dyes which cannot be used, as they stain the film of gum deeply and thus injure the preparation.

THE RETRACTILE TENTACLES OF THE PULMONATA.—The retraction of the eye-bearing tentacles of a land snail in the process of hardening may be prevented in the manner described by Flemming.[4] These organs, as is well known, are hollow cylinders,

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] Arch. f. mik. Anat , XXV, p. 141–143, July, 1885.

[3] Arch. f. mik. Anat., XXV, p. 52, April, 1885.

[4] Arch. f. mik. Anat., 1870, VI, p. 440; Zeitschr. f. wiss. Zool., 1872, XXII, p. 366.

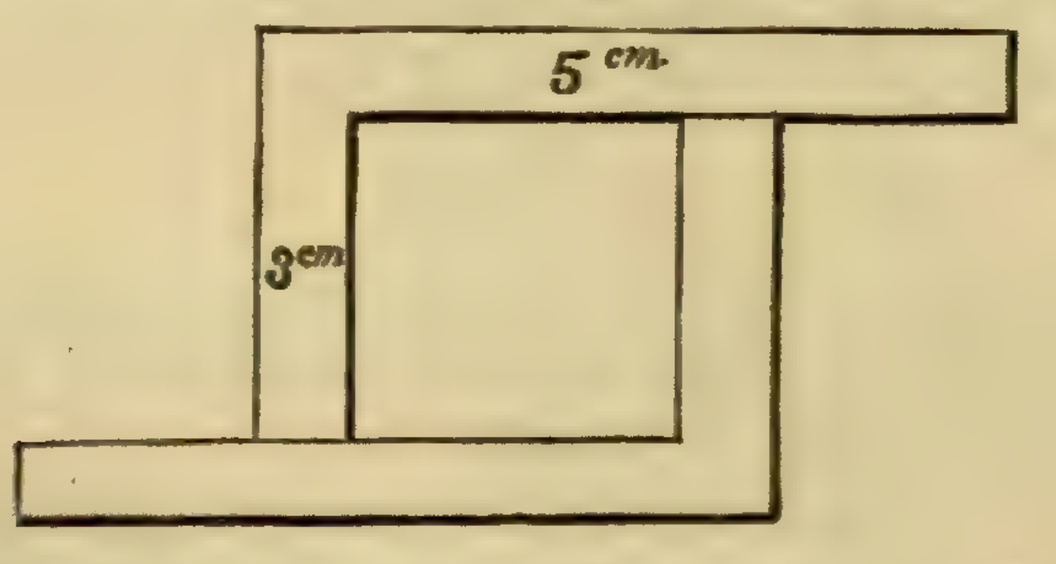
which can be rolled in like the finger of a glove by the action of a retractor muscle. The eversion is effected by forcing blood from the body-cavity into the lumen of the tentacle. If, when the tentacle is fully extended, a thread be quickly tied around its base so as to prevent the escape of the blood, the infolding process cannot take place, and the hardening fluid may then be safely applied. Flemming recommends treatment with bichromate of potassium (4 p. c.). This method enables one to obtain sections of the eye in the extended condition of the tentacle.

Imbedding in Paraffine.—*Clarifying media.*—Cedar-wood oil is recommended by Lee[1] as a clarifying medium on various grounds, the more important of which are the following:

1. It clarifies as rapidly as clove oil.
2. It does not render the object brittle or excessively hard.
3. It is a much better solvent of paraffine than clove oil; and hence only a short paraffine bath is required.
4. The penetration of the paraffine is not only more rapid, but also more thorough.

Holl[2] recommends toluol, which he finds can be used to greater advantage than chloroform, especially with large objects. The largest objects should be left one day in toluol, and one day in the paraffine bath; small objects require correspondingly shorter times.

Imbedding Box.—A convenient box, introduced by Dimmock, may be made of two pieces of type metal (or better of brass). As will be seen from the accompanying diagram, each piece of



metal has the form of a carpenter's square. A convenient size will be found in pieces measuring 5^{cm} (long arm) by 3^{cm} (short arm) and 7^{mm} high. With such pieces a box may be constructed at any moment by simply placing them together on a plate of glass which has previously been wet with glycerine, and gently warmed. The area of the box will evidently vary according to the position given to the pieces, but the height can be varied only by using different sets of pieces.

It is well to imbed in a thin layer of paraffine, so that the object, after cooling, may be cut out in small cubical or pyramidal

[1] Zool. Anz., No. 205, p. 563, Oct., 1885.
[2] Zool. Anz., No. 192, p. 223, April, 1885.

blocks, which may be easily fixed, for cutting, to a larger block of hard paraffine, or better, to a block of wood saturated with paraffine.

ORIENTATION WITH SMALL OBJECTS.—Orientation becomes difficult only with objects so small that their position can be controlled only by the aid of a microscope. Spherical objects, less than one millimeter in diameter, *e. g.*, many ova and embryos, are the most difficult to manage. Such objects may usually be successfully oriented in the following manner:

1. Prepare the box; for this it will be necessary to use the two triangular pieces of metal, a rectangular glass plate (2 in. x 2½ in.). The plate should be cleaned and then smeared with glycerine, and the pieces of metal so adjusted, that the arms are parallel with the edges of the plate.

2. Having warmed the box over a spirit lamp, lift the object from the basin of paraffine by the aid of a *small*, *flat*, *thin* spatula (first starting it from the bottom by shaking the paraffine a little), and allow it to *flow* with the paraffine carried on the spatula into the box.

3. Then fill the box (5–6^{mm} deep) with the melted paraffine, and warm it a little over a spirit lamp, just enough to keep *all* of the paraffine in a liquid condition for a few moments. Now place the box on the warm table of a dissecting microscope, and by the aid of a hot needle proceed to place the object in the desired position. As the object is illuminated from below, it can be easily seen, turned over, and moved about at pleasure. If the paraffine freezes before orientation is effected, it should be melted again as before, and the needle must be kept hot by repeatedly holding it in the flame of the lamp.

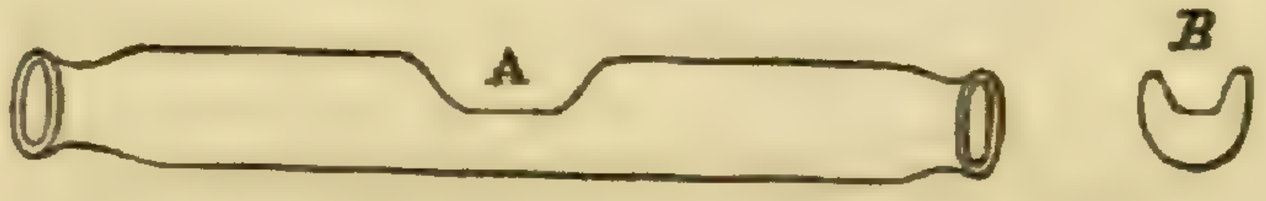
The difficulty of finding very small objects in a basin of paraffine will be very much lessened by keeping the paraffine free from dust, and the bottom of the basin (tin) scoured bright. A piece of emery cloth serves for polishing.

The necessity of re-warming the box of paraffine, which often arises in the above method, may be removed by using a hot bath on the table of the microscope. This bath should be a box of convenient size (not over 2^{cm} high), with top and bottom of glass, with an opening at one end for filling with hot water, and another at the opposite end provided with a rubber tube and clamp, for drawing off the water as soon as the object has been arranged.

PREVENTION OF BUBBLES.—After the imbedding process has been carried thus far, there is still another danger to be carefully guarded against. If the box is left to cool slowly in the air, bubbles are very likely to appear in the paraffine, which will prove a serious obstacle in cutting. Profiting by Caldwell's suggestion, to cool the box in water, one may avoid all such inconveniences. As soon as the paraffine cools around the object, so

that its position is secured, the box should be held in a vessel o cold water, first at the surface (until the paraffine has set), then fully submerged. In this way the paraffine is quickly cooled sufficiently for removal from the box, which may then be used for imbedding a second object. A dozen objects may be thus imbedded in a very short time. If the box is plunged below the surface of the water, before the paraffine has become rigid, holes will arise in the mass and fill with water.

Box and Warm Bath Combined.—Selenka[1] has recently described a simple apparatus for imbedding small objects in a definite position. It is made by taking a thin glass tube, and heating one side at the middle until it becomes soft enough to bend easily. Then the mouth is applied to one end while stopping the other with the finger, and the air sucked out, causing the softened portion to bend inward and thus forming a shallow trough, A. A section of the trough is shown in B. In order to make the bottom of the trough flat, it is only necessary to place in the tube, before



Selenka's Imbedding Box (reduced ½).

heating, a strip of glass, against which the infolding portion of the tube will flatten.

One end of the cylinder is joined by rubber tubing with a T-shaped tube, one arm of which connects with a somewhat elevated liter glass of cold water, and the other arm with the hot water of the water-bath. The connection with the water reservoirs is through rubber tubing, which can be closed by pinch-corks. The other end of the glass cylinder is also provided with a rubber tube through which the water flows into a vessel standing on the floor.

The cylinder is fastened (by string or clamp) to the table of a dissecting microscope, with the trough at the centre. The hot water is then turned on and allowed to flow slowly. The trough is next filled with melted paraffine by the aid of a hot pipette, and the object dropped in and oriented with a needle. As soon as the object is placed in the desired position, the cold water is turned on, which causes an immediate stiffening of the paraffine. The hot water is shut off, and after a few moments, the paraffine with the imbedded object can be removed from the trough. The trough should be washed with absolute alcohol before imbedding.

[1] Zool. Anz., No. 199, p. 419, July, 1885.

SCIENTIFIC NEWS.

— Henry P. Bowditch, Francis A. Walker, William Minot, Jr., and Charles S. Minot, have signed a declaration of trust for the Elizabeth Thompson Science Fund. Mrs. Thompson has presented $25,000 in trust to these gentlemen "to be the means of ennobling and promoting investigation and the study of science for the sake of science and the benefit of mankind." This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations, *not already otherwise provided for*, which have for their object the advancement of human knowledge, or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Applications for assistance from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The applications should be forwarded to the secretary of the Board of Trustees, Dr. C. S. Minot, 25 Mt. Vernon street, Boston, Mass., U. S. A.

The first grant will be made early in January, 1886.

— Dr. William Benjamin Carpenter, LL.D., F.R.S., an eminent English physiologist, died in London, Nov. 11. He published an important work entitled, Principles of General and Comparative Physiology. His reputation was widely extended by an excellent work called, Principles of Human Physiology. For many years he edited the *British and Foreign Medico-Chirurgical Review.* He will also be remembered for his work on the physics of the ocean, on Foraminifera and crinoids, as well as for his treatise on the microscope. Dr. Carpenter died from the effects of terrible burns caused by the upsetting of a lamp while he was taking a vapor bath for rheumatism.

— A telegram from Memphis says that "millions of squirrels are emigrating from the Mississippi side over to the Arkansas shore at a point commencing about five miles below Memphis and extending down for twenty miles. They are swimming the Mississippi river and evidently making for more elevated grounds in Arkansas. Thousands are being killed by farmers, who, by reason of their great numbers, use sticks instead of guns. A similar emigration of squirrels occurred in 1872."

— We willingly correct an error into which we fell in our last number. Besides the Comision Cientifica of Mexico, there is a Comision Geographico-Exploradora, of which the director is Señor Augustin Diaz. Professor Ferrari-Perez is the chief of the Section de Historia Natural of the latter. This gentleman is at present in the United States engaged in identifying the natural

products of his country as represented in our museums and libraries.

— Thomas Davidson, the English scientist, is dead, at the age of 68. His researches were principally connected with geology and palæontology. His large work on British Fossil Brachiopoda, in five quarto volumes, will be, when published, one of the most complete palæontological monographs ever published. He has also published eighty scientific papers. His collection was bequeathed to the British Museum.

— The board of regents of Kansas State University, at a recent meeting unanimously resolved to name the new museum ldguinib in process of erection, "Snow Hall of Natural History." This is a deserved compliment to Professor F. H. Snow, whose connection with the institution has been one of the mainsprings of its success.

— The death of M. Charles Robin, the eminent histologist, is announced from Paris. He had been professor of histology at the Faculty of Medicine since 1832, and was in his 65th year. In 1871 he worked with Littré in founding the Society of Sociology, and by his death the Senate loses all but the last of its scientific men.

— The October number of the Johns Hopkins University Circular embraces a résumé of the work done in the Chesapeake Zoölogical Laboratory, under the direction of Professor Brooks, from May to September, 1885. It shows that much successful work was done during the season.

— At the meeting of the Linnean Society of New South Wales, for May 27, Dr. Lendenfeld announced the discovery of sensitive and ganglion nerve-cells in the horny sponges, similar to those which he had observed as occurring in calcareous sponges, but much larger.

— Dr. William Wood, of East Windsor Hill, Conn., died August 9, 63 years old. He was an excellent local ornithologist, several of his papers appearing in the early volumes of this magazine.

— The Annales des Sciences Naturelles, XIX, No. 1, contains discourses by Professors Quatrefages, Blanchard and Lacaze-Duthiers, pronounced at the funeral of Milne-Edwards.

— The *Kansas City Review* comes to us in a new dress and with additional interest in its contents. The labor of years devoted to it by Col. Case is evidently meeting its just reward.

— James Macfarlane, author of Geological Railway Guide and Geologists' Traveling Hand-Book, died October 12, at Towanda, Penna., aged 66.

— Dr. H. A. Atkins, of Locke, Mich., also a good local ornithologist, died May 19, aged 63.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, Oct. 31, 1885.—Communications: Col. Marshall McDonald, Fish-culture a necessity for the maintenance of the shad fishery; Mr. Wm. H. Dall, Deep-sea mollusks and the laws illustrated in their development; Mr. Richard Rathbun, Remarks on the Woods Holl station of the U. S. Fish Commission; Mr. Romyn Hitchcock, Notes on the ed snow, with exhibition of specimens.

NEW YORK ACADEMY OF SCIENCES, Oct. 5, 1885.—The following papers were presented: On the agatized woods and the malachite, azurite, etc., from Arizona (illustrated with specimens of all, and with microscopical sections of the fossil woods); also, Some notes on the new meteorite that feil in Western Pennsylvania, by Mr. Geo. F. Kunz.

Oct. 19.—The following paper was presented: On a phosphorescent flagellate infusorian, probably a new species of Noctiluca, from the surf at Ocean Beach, N. J. (with an exhibition of the phosphorescence, and of preparations under the microscope), by Dr. Alexis A. Julien.

Nov. 2.—Dr. J. S. Newberry addressed the academy upon the recent Geological Congress at Berlin, its objects, its results and its men.

BOSTON SOCIETY OF NATURAL HISTORY, Oct. 7.—Dr. S. Kneeland described the family-life of the Norwegian Lapps, and the habits of the reindeer.

Oct. 21.—Dr. S. Kneeland exhibited models of two memorial gravestones of the iron age, from Central Sweden, bearing Runic inscriptions and other symbols.

Nov. 4.—Professor F. W. Putnam related the circumstances under which the skulls of a mastodon and of a man were found together at Worcester, Mass.; Mr. Wm. M. Davis spoke of the drift-formations in which the skulls were buried.

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